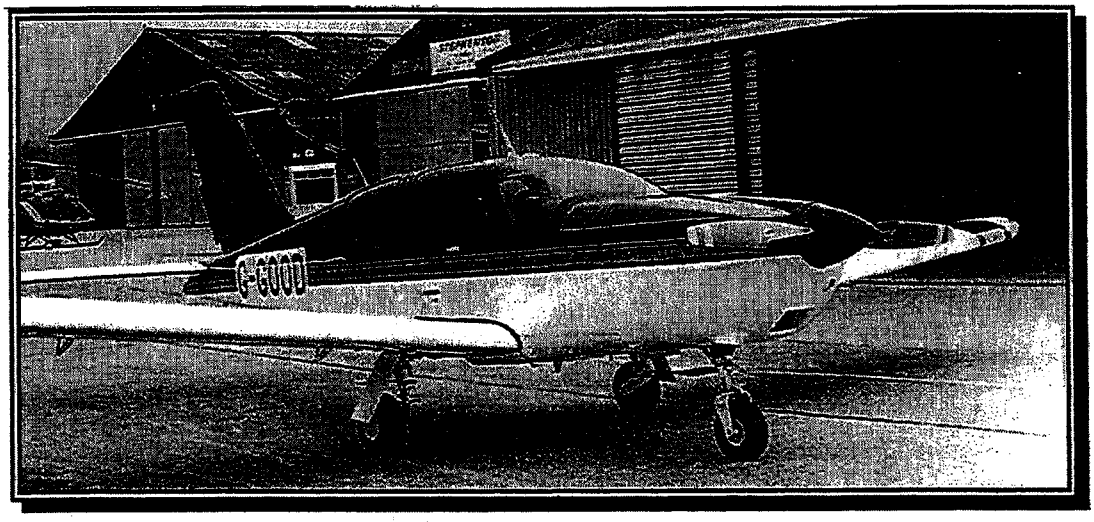
INSTALLATION MANUAL



COLOUR SKYMAP & TRACKER
CM2000 & CT2000

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AMENDMENT RECORD

RECORD OF CHANGES	DATE
Revision 1:- Initial Issue	28th June 1996
Revision 2:- Incorporates details of the Rack Assembly to the Aircraft and associated Parts required to complete the Assembly.	3rd July 1996
Revision 3:- Clarifies and adds details of the electrical inputs and outputs to the Colour Skymap	11th February 1997
Revision 4:- Amends Crimp tool part number, page 12, Compass Safe Distance amended to 100mm, was 300mm.	23rd June 1997
Revision 5:- Introduces the Flight Manual Supplement GAL/SUP/001 for use with the KAP1** Series of HSI/CDI/Autopilot systems. Defines the baseline standard for the CM2000 hardware and Software for HSI/CDI/Autopilot use.	2nd December 1997
Revision 6:- Amends the Flight Manual Suplement in line with CAA comments and removes all referance to Glide Slope outputs.	29th January 1998
Revision 7:- Reference to Version 3.00 software and MOD 5 added along with history of hardware modifications to the system to allow identification of significant changes to the systems.	27th April 1998

Colour Skymap™ & Colour Tracker™

Installation and Operating Manual

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Manual Revision 2.4

Unit Software Version 2.10 or above

Internal Aeronautical Database is supplied courtesy of Jeppesen®

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INTRODUCTION

All of us at Skyforce congratulate you on choosing this product. You are now the owner of one of the most sophisticated yet simple-to-use Navaids available today. We understand you probably can't wait to see it in action but before you try to use it do please take the time to read through this Manual and understand its many interesting and useful features. Time spent in familiarising yourself with your new Skyforce unit will be more than repaid by trouble-free operation later, and more importantly safe and accurate navigation.

We have made the operation of this unit as intuitive as possible through the use of soft keying and on screen help, thus reducing users' dependence on the Manual. You should very quickly find that handling it efficiently and expertly becomes second nature to you. Don't be afraid to experiment. No matter which Key you activate, your unit will not be damaged. If you do get into a mess, simply switch off and back on again to reset all functions. We must mention just one word of caution. Never remove the memory module whilst the unit is switched on and never attempt to switch the unit on when there is no memory module fitted.

Whichever model of our equipment you have chosen, we at Skyforce are sure you will be pleased with its performance. We thank you for your custom and wish you many happy and safe hours flying.

WARNING

The Global Positioning System (GPS) satellite constellation is operated by the Department of Defense (DoD) of the United States which is solely responsible for its accuracy and maintenance. Although declared fully operational on July 17th 1995, the system is still under development and subject to changes which could affect the accuracy and performance of all GPS equipment.

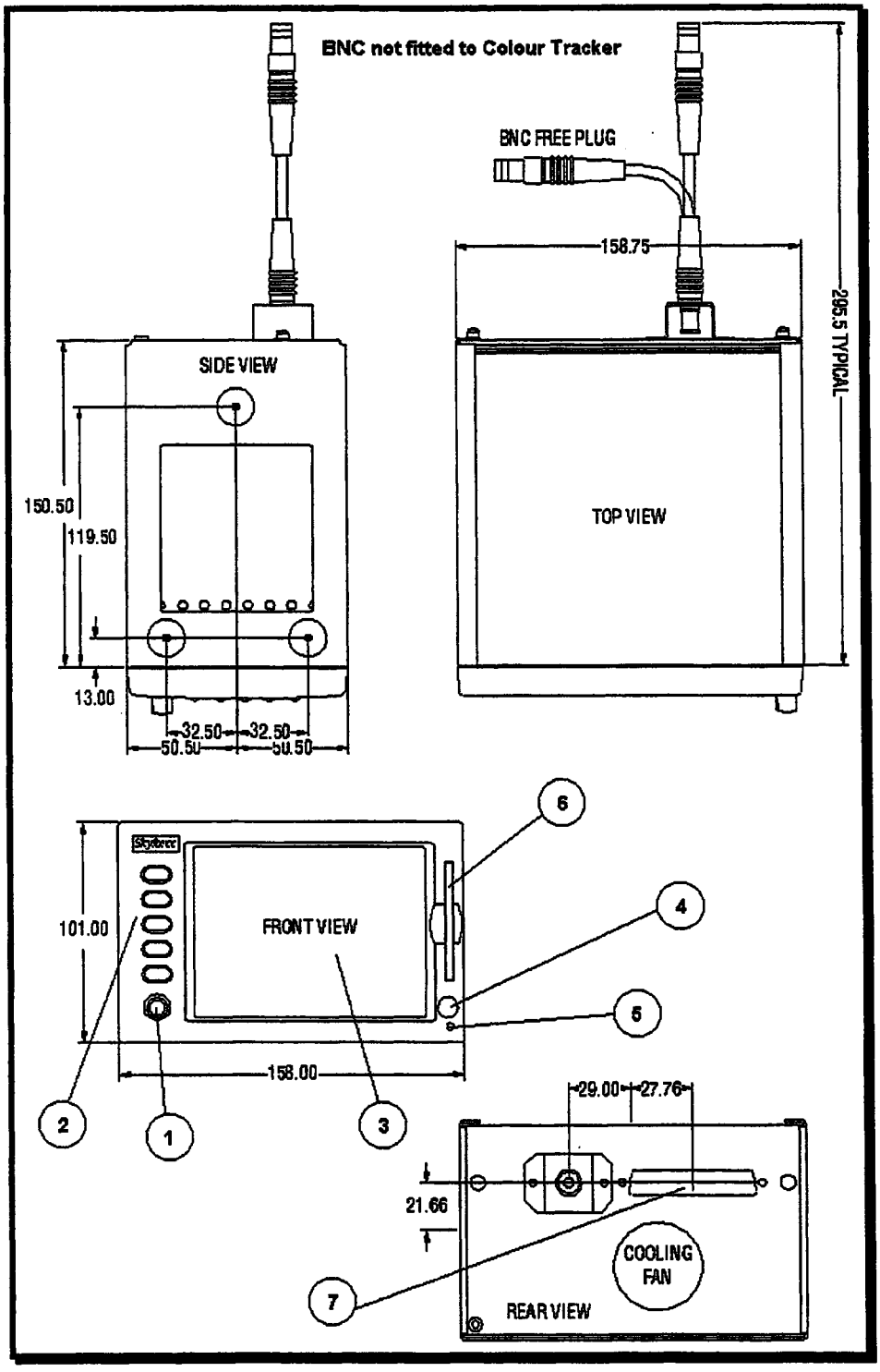
Use this equipment at your own risk. Your new Skyforce equipment is a precision navigation aid but like any navaid it can be misused or misinterpreted and so become unsafe. You are strongly advised to read and fully understand this Manual before using it. Your unit has a DEMO MODE or simulation facility that allows you to practice with it before you begin using it for actual navigation.

Whenever you are using the unit for navigation in the air you should treat it as a **supplemental navigation system.** You should always carefully compare indications from your Skyforce equipment with the information available from all other navigation sources including NDBs, VORs, DMEs, visual sightings, charts, etc. For safety, any discrepancies observed should be resolved immediately.

The altitude calculated by GPS equipment is geometric height above a theoretical mean sea level of a mathematically-calculated ellipsoid that approximates to the shape of the earth. This altitude can differ significantly from that displayed by your pressure altimeter. You must therefore **NEVER USE GPS ALTITUDE FOR VERTICAL NAVIGATION OR TERRAIN CLEARANCE.**

This equipment is not a replacement for your chart. It is intended as an **aid to VFR navigation only.** The database within the equipment has been compiled from the latest official information available, and although every care has been taken in the compilation, the manufacturers will not be held responsible for any inaccuracy or omissions therein.

A QUICK LOOK AT YOUR UNIT



KEY TO DRAWING

1. Joystick
2. Function Keys
3. Liquid Crystal Display
4. ON/OFF/BRIGHTNESS
5. Clamping Screw Port (Secures unit into Mounting Tray)
6. PCMCIA SkyData Module
7. 37 Way D Type Connector.

Standard Accessories

Mounting Tray
Power/Data Connector
Operating Manual
Getting Started Card

Optional Accessories

External Low Profile Antenna Kit
PC Interface Kit

GENERAL INFORMATION

This section of the Manual explains how it should be used and provides you with an overview of the software architecture and screen presentation of your Skyforce unit.

The Manual takes you step by step through each of the Screens that are displayed on your Skyforce unit. All Screens are numbered and indexed at the front of this Manual for quick reference.

The operating system of the Skyforce Colour Skymap and Colour Tracker has been developed from the highly successful Mk 1 Skymap software. This new operating system greatly reduces the number of Key presses necessary to activate the various functions, especially those most frequently used in the air. The provision of a joystick makes it considerably simpler to operate the unit and allows you fast and efficient access to most functions. In this Manual reference is frequently made to moving, or pressing a button on, a mouse. This refers to the computer style mouse that can be supplied as part of the optional Mouse Kit.

Soft Keying

You will notice that a label is drawn alongside each valid Key. Whenever a new screen is selected, by pressing a valid Key, a new page is displayed along with its new Key labels. This capability of drawing Key labels that are only applicable to a particular page is referred to as soft keying, and allows one key to perform multiple functions without the complications of multi key presses on a conventional keypad.

For the purpose of describing the function of a particular Key in this Manual, assume that all the Keys on the pictured Screen drawings are numbered 5 - 1 from top to bottom. The ensuing text will use this numbering sequence to refer to each specific Key. The number shown alongside the pictured Screen drawings refers to the number of the Screen which is called when that Key is pressed. By using these numbers it is possible to follow the paths through the operating system for all functions. If the word RET is printed next to a Key, this means that after the Key function is performed the same Screen is RETurned. A good example of this is ZOOM IN. All Screen drawings show the full Colour Skymap version of software in Landscape Standard mode. Variations affecting Colour Tracker are described in the accompanying text.

Screen Orientation

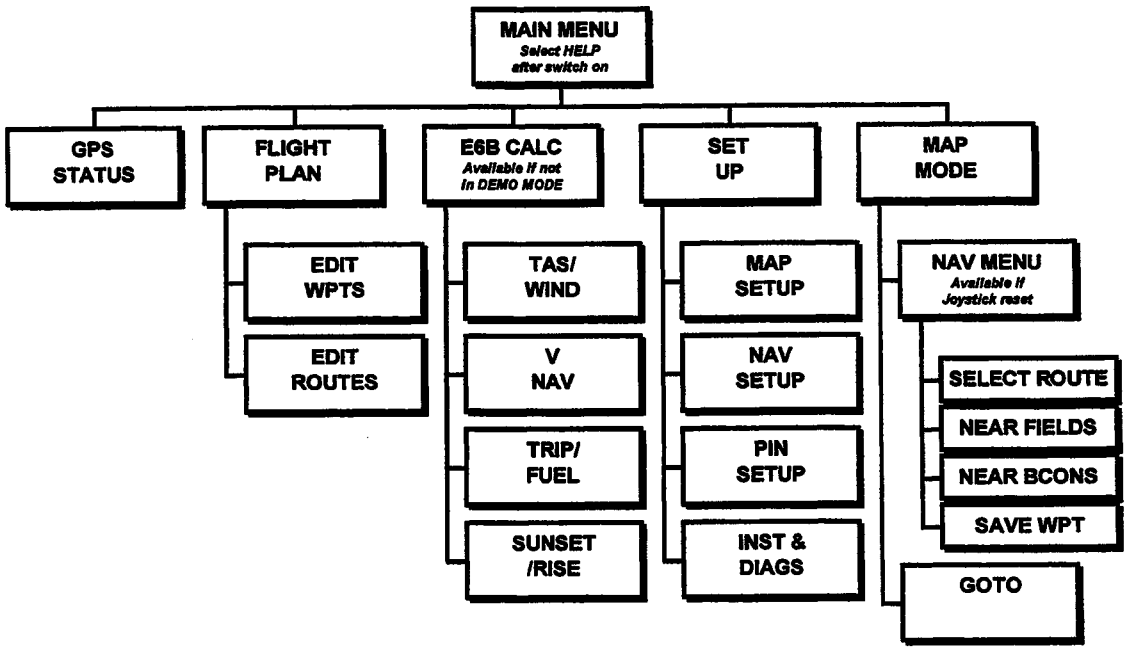
The Colour Skymap and Colour Tracker software can be run in one of four display modes and so allows you to mount the unit either horizontally (either landscape standard or inverse) or vertically (either portrait standard or inverse). This enables the user to configure the unit for either left or right handed operation or place the Keys along the left, right, top or bottom edges of the case. The default setting on first switch on is Landscape Standard, and it is this mode that is used to illustrate the functions of your unit in this Manual. Refer to Map Setup Screens in the Setup Screens Section of this Manual if you wish to alter your screen orientation.

Software Architecture

The software in your Skyforce unit is tree structured, an analogy can therefore be drawn between the trunk of a tree and MAIN MENU. MAIN MENU is the heart of the operating structure and can be accessed by pressing the **HELP** key within 30 seconds after switching on the unit.

MAIN MENU has 5 main software branches which in turn have their own sub software branches. The diagram below depicts the complete tree structure and will serve as a good point of reference whilst you are familiarising yourself with your unit.

Software Architecture



GPS STATUS Shows satellite signal strength, allows GMT, local offset, date and position to be set, which will speed up the initialisation of your unit.

FLIGHT PLAN Allows user defined waypoints and routes to be edited/created.

EDIT WPTS Allows user defined waypoints, airfields and marker functions to be edited/created either manually or visually.

EDIT ROUTES Allows user defined routes to be edited /created either manually or visually.

E6-B CALC Allows the E6-B Calculator to be used. This Key is only available if **DEMO MODE** is not on. **DEMO MODE** can only be selected from the first screen after unit switch on.

TAS/WIND Allows density altitude, TAS and winds aloft to be calculated.

V NAV Allows vertical navigation to be setup.

TRIP/FUEL Allows fuel and trip information to be calculated.

SUNSET/RISE Allows sunset and sunrise times to be calculated.

SETUP Allows setup of map, navigation and input/output characteristics.

MAP SETUP Allows all map functions to be customised, including map tracking, airfield names, map units, map datum, display orientation, language, minimum runway length/surface, extended track , auto zoom and zoom level map de-clutter facility.

NAV SETUP Allows all the nav functions to be customised, including CDI scale, CDI display, CDI alarm, arrival alarm, auto next leg/leg selection philosophy, split screen/large map nav mode and logging rate.

PIN SETUP Allows the PIN security function to be setup.

INST & DIAGS Allows installation diagnostics for data input/output, and GPS receiver (Colour Skymap only) to be performed. Flight logs can be viewed and various sections of memory can be cleared from here.

MAP MODE This is the primary operating mode of the unit. The unit will automatically drop into this mode 30 seconds after switch on if no other Key is activated.

NAV MENU Allows access to all navigation functions. The joystick toggles the Nav Mode.

SELECT RTE Allows a route to be selected and edited.

NEAR FIELDS Allows emergency search of 10 nearest fields, providing information and GOTO capability. Includes Jeppesen and user defined airfields which satisfies the minimum runway length and surface requirements.

NEAR BCONS Allows emergency search of 10 nearest beacons (VORs and NDBs), providing information and GOTO capability.

SAVE WPT Allows your present co-ordinates to be saved in the next available waypoint number.

GOTO Allows the user to GOTO any point in the internal or user defined database. May also be used to obtain information on any point in the database.

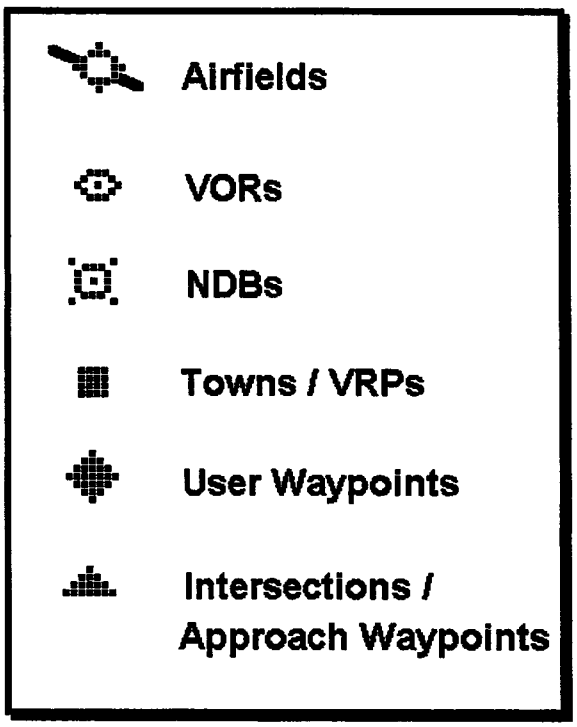
There are short cuts allowing you to get to the primary operating mode, MAP MODE, more easily, but in general if you wish to get to a specific function in another branch of software, work your way back down the present branch to MAIN MENU by pressing either the **ESCAPE** or **MAIN MENU** key, then select the branch of software that contains the desired function you wish to access.

Memory Locations

In the function descriptions, three types of memory, EPROM, RAM and NVM, are mentioned. You may find it useful to know where various types of information are stored in order to make best use of the equipment. The EPROMs (Erasable Programmable Read Only Memory) are in the SkyData Module and are used to hold the operating system and the database. The SkyData Module can be replaced periodically in order to upgrade the operating system and update the database. The RAM (Random Access Memory) is built into the unit and is used to store all user-defined data such as Waypoints and Routes. The RAM is maintained by battery power from an internal long-life lithium cell. This lithium cell will need to be replaced at intervals of around 3 to 5 years and should be done by your Skyforce dealer. The NVM (Non Volatile Memory) is also built into the unit. It stores initialisation data, serial number, PIN number and performance log details. This memory is non-volatile which means it is retained even when external power is removed. If you choose to activate the PIN number security feature (similar to that available on many car radios) the non-volatile nature of the NVM ensures your PIN can not be tampered with or erased.

Screen Icons

When showing any map screen - airfields, beacons, towns, intersections, user and approach waypoints are represented by the symbols or icons shown.



ANTENNA CONSIDERATIONS

Your Colour Skymap will need to be connected to an antenna for normal operation. For permanent external mounting an external low profile "tear drop" style antenna is available. Where there is no suitable mounting location or you simply don't wish to make a hole in the aircraft structure to support such as antenna, a portable antenna can be purchased for internal use from your Skyforce dealer. The portable antenna may be held in place by using the rubber suction cup supplied (which should be slotted into the key hole in the antenna bracket) or fixed permanently in position by using the countersunk screw mounting holes in the antenna bracket. The portable antenna kit comes complete with a 6ft 5" (2 meters) extension cable and therefore can be mounted up to this distance from the main unit. The portable antenna is only splash proof and not fully waterproof and should not be mounted permanently outside the aircraft.

Always ensure that the domed face of the antenna can "see" a large area of the sky, preferably right down to the horizon. In order to provide a 3-dimensional fix, Colour Skymap needs to receive signals simultaneously from at least four satellites.

The radio signals from the GPS Navstar satellites are transmitted in an extremely high frequency band. They can be regarded as having approximately the same penetration capabilities as light. This means that they are able to penetrate only transparent or very thin materials and will be blocked by almost any material that blocks light.

At least four and at times up to eight GPS satellites should always be in view from any place in the world at any time. These can, however, be absolutely anywhere in the sky and so, to ensure uninterrupted navigation it is essential that the antenna has direct line-of-sight contact with as much sky as possible.

TITLE AND HELP SCREENS

To switch the unit on, rotate the ON/OFF/BRIGHTNESS knob fully clockwise.
Your unit produces a variety of tones and alarms to assist you in correct operation. At this stage only two types of tone need concern you. These are:

1 short beep sounds when you press a valid Key.
2 short beeps sound when you press a Key that is not assigned.

Screen 1: Title Screen

The Title Screen appears each time the unit is switched on. When the Title Screen first appears no Key labels will be shown until the unit's self-test and initialisation routines have been completed. The Title Screen will stay on for 30 seconds then Screen 38, Map Mode, will automatically appear. However any of the Keys may be pressed during the 30 second period to call other Screens.

Key 1 calls Screen 2 which is the Main Menu Screen.
Key 2 calls Screen 7 which is the Flight Planning Mode Cover Screen.
Key 3 calls Screen 20 which is the Demo Mode Setup Screen. (If, since being switched on, the unit has received valid fix information from the internal GPS receiver (Colour Skymap) or from an external device (Colour Tracker), Key 3 DEMO MODE will for safety reasons be blanked and disabled.) This is the only Screen on which Demo Mode can be activated.
Key 4 calls Screen 21 which is the Setup Cover Screen.
Key 5 calls Screen 38 which is the Map Mode Screen.

To switch the unit off, turn the ON/OFF/BRIGHTNESS knob fully anti clockwise.

Self Test and Initialisation

As mentioned above, the Title Screen will initially be displayed without Key labels whilst a series of internal check routines are carried out automatically by the unit. These are:

1. Verification that the unit has been factory initialised. This consists of a check to see if there is a special code in NVM. If there is no initialisation code in the NVM a message saying UNIT NOT INITIALISED will be printed across the centre of the Screen and the unit will be totally disabled. This is a security feature, safeguarding against theft of the unit and attempted erasure of your PIN from the NVM. (If your unit is stolen and the NVM is erased or replaced in an attempt to reset the PIN, the thief will still not be able to use or sell the unit because these special high security factory initialisation codes will be missing.)

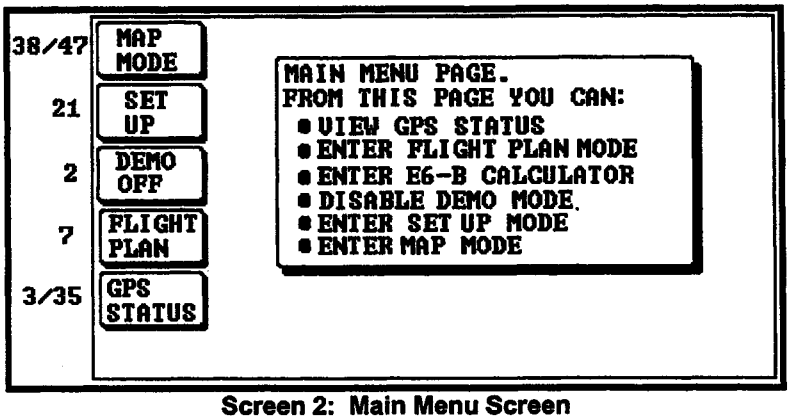
2. A check for RAM corruption. If RAM has been lost or corrupted due to loss of power in the lithium battery, Screen 51 will be displayed (Refer to Appendix 01).

3. A check to see whether the Automatic Power-On Lock function has been enabled (see Screen 26 for further details). If it is enabled, Screen 54 will be displayed after 5 seconds (or if any Key is pressed before this). If when switched on it is found that three unsuccessful attempts have been made to enter the Unlock PIN, Screen 55 will be displayed (Refer to Appendix 01).

4. A check to see if a new SkyData Module has been fitted. This involves comparing the software version number held in NVM with that of the current SkyData Module. If a change of module is detected, the integrity of routes will be checked and if any discrepancies are found Screen 56 will be displayed. (The notes accompanying Screen 56 in Appendix 01 give more details of these integrity checks.)

If the unit passes all checks 1 to 4 above, the Keys will automatically appear on Screen 1. Screen 38, Map Mode, will then be displayed after 30 seconds if no Key is pressed.

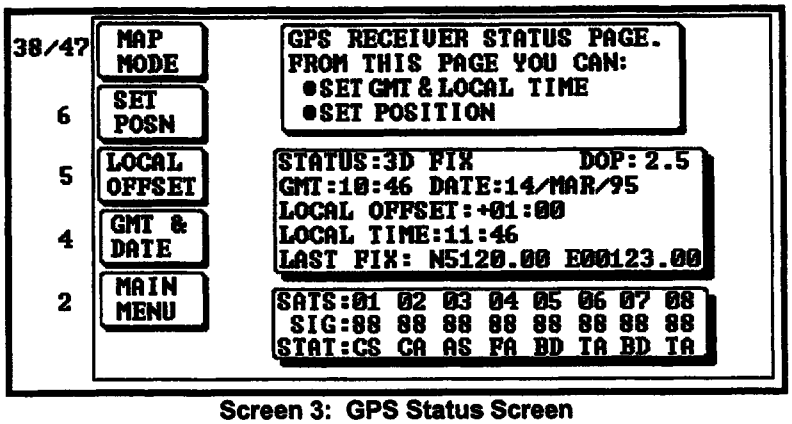
Main Menu Screen



Screen 2: Main Menu Screen

On Colour Skymap units, Key 1 calls Screen 3 which is the GPS Status Screen. On Colour Tracker units, Key 1 is labelled DATA IN/OUT and will cause Screen 35, Data Input/Output Setup and Test Screen, to be displayed. Key 2 calls Screen 7 which is the Flight Planning Mode Cover Screen. Key 3 will read E6-B CALC if DEMO MODE was not selected on Screen 1. Pressing Key 3 when labelled E6-B CALC will call Screen 57 which is the E6-B Calculator Cover Screen (Refer to Section on E6-B Calculator). If Demo Mode has previously been activated, Key 3 will read DEMO OFF. Pressing DEMO OFF will then switch Demo Mode off and return to Screen 2 with Key 3 reading E6-B CALC. Key 4 calls Screen 21 which is the Setup Cover Screen. Key 5 calls Screen 38 or 47 which are Map Mode and Map Mode with Nav Information.

GPS STATUS SCREENS (Colour Skymap only)



Screen 3: GPS Status Screen

The GPS Status Screen will display the receiver STATUS. This can be any of the following:

BAD ALMANAC	**<3 SATS**	**DIFFERENTIAL**	**ACQUIRING**
2D FIX	**3D FIX**	**POOR DOP**	**POS PROP**

The meanings of these displays are:

BAD ALMANAC means the GPS receiver's information concerning satellite positions is out of date. If this occurs the unit should be left alone with the antenna connected and in view of the sky for approximately 15 minutes during which period it will automatically lock onto a satellite and load an up-to-date almanac.

<3 SATS means that according to the current information available, there are less than three satellites in view and a fix can not be calculated. This message is very rarely displayed.

DIFFERENTIAL means that the Colour Skymap has a fix and is also receiving differential correction signals from an external source. (Refer to Appendix 04 for further details concerning differential operation.)

ACQUIRING means the unit is currently searching for satellites or is loading information from one or more satellites.

2D FIX means the unit is calculating position in two dimensions (i.e. latitude and longitude only, with no height information).

3D FIX means that the unit is calculating position in three dimensions and can give latitude, longitude and height information.

POOR DOP means that the unit is unable to calculate position owing to the poor geometry of the visible satellites. (DOP stands for Dilution of Precision.)

POS PROP means that navigation has been temporarily lost and the Colour Skymap is dead-reckoning (or propagating) its position based on the last known position, track and ground speed. It will not dead-reckon for more than a few seconds at a time.

Other information which is displayed on this Screen includes:

DOP (Dilution of Precision) This is a number between 00.0 and 99.0 that represents the dilution of quality of the calculated fix due to satellite geometry. 00.0 is best, 99.9 is worst. If this figure is greater than 5.0, performance of the system is likely to be degraded because some of the visible

satellites appear too close to each other. DOP is calculated from the angular separation between the various visible satellites. Greater separation results in better fix geometry and a lower DOP. (This DOP figure is not measured in any specific units.)

GMT/DATE which is Greenwich Mean Time and Date.

LOCAL OFFSET which is the difference between GMT and local time.

LOCAL TIME which is calculated by adding Local Offset to GMT.

LAST FIX. If the unit does not have a current valid fix, this is the position at which it last had a fix. If the unit has a fix, this is the present position.

SATS (eight satellite numbers), **SIGS** (signal strength for each satellite) and **STAT** (status of each satellite).

Each satellite has a PRN (Pseudo Random Noise) or identification number. The satellite PRN numbers are displayed in a line beside the word SATS. (If you contact one of the information sources mentioned in Appendix 05, you will hear the satellites referred to by these PRN numbers.) The two digit number under each PRN number is an indication of the signal strength being received from that satellite. Best is 99, worst is 00. These numbers can be used for finding and eliminating electrical interference. Readings of 60 and above indicate a good installation.

Under each signal strength number is a two character code. These indicate the status of each satellite. These codes are: CS, CA, AS, FA, BD, MD, TA, EA, AP. These relate to the eight possible receiver modes and are detailed below.

CS : Code Search. This is the receiver's initial stage in acquiring a satellite. It means that the receiver is trying to match its internal code to the satellite signal.

CA: Code Acquire. This means the satellite code has been received and matched to the receiver-generated code.

AS: AGC Set. This means the satellite strength has been assessed and the Automatic Gain Control has been set.

FA: Frequency Acquire. This means the receiver has correctly locked onto the satellite data frequency.

BD: Bit Sync Detect. This means the receiver is synchronised with the satellite's data bit stream.

MD: Message Detect. This means the receiver is synchronised with the satellite's message stream.

TA: Time Available. This means the satellite is fully locked in and has sent down GMT time and date information to the receiver.

EA: Ephemeris Acquire. This means the receiver is reading the constellation health status message from the satellite. This usually takes around two minutes.

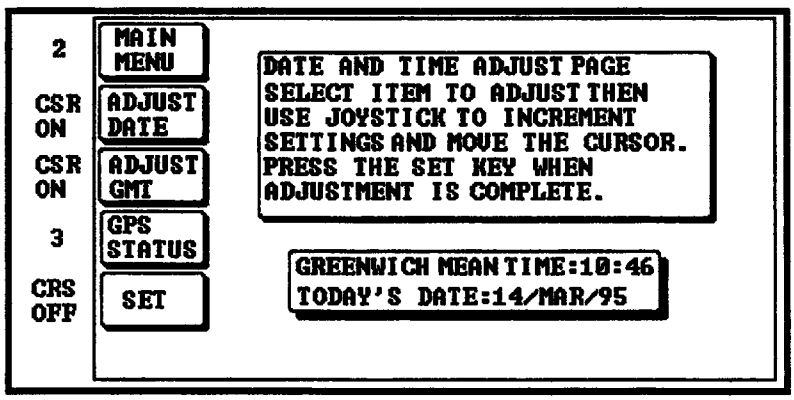
AP: Available for Position. This means the satellite is fully locked in and tested and can be used for calculating position. A minimum of three satellites are necessary for a 2D fix.

Key 1 returns to Main Menu. Date, Time, Local Time Offset and Present Position can be adjusted by selecting one of Keys 2, 3 or 4. Direct access to Map Mode is available by pressing Key 5.

When using the Colour Skymap for the first time (or after it has been relocated by more than 100 miles since it was last used) setting up the present position (to within 50 miles or so) and ensuring that GMT and Date are correct (to within a few minutes) will considerably speed up the TTFF (time to first fix). It

is not absolutely necessary to do this, since given time, the receiver is quite capable of working out its own position.

Adjusting Time and Date

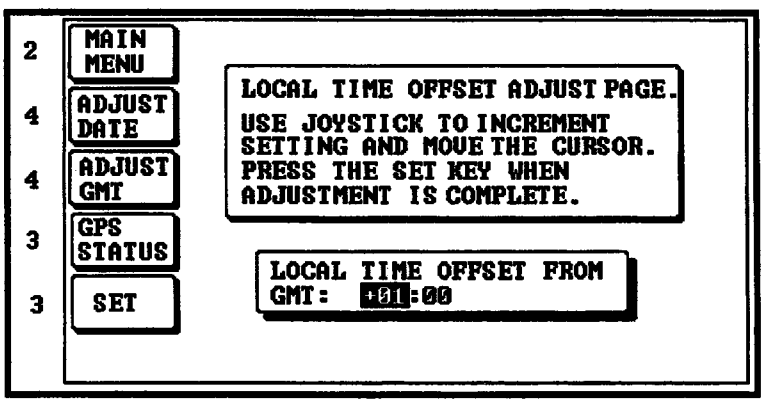


Screen 4: Date and Time Adjustment Screen

This Screen is accessed by pressing GPS STATUS in Main Menu followed by GMT & DATE. Pressing Key 3, ADJUST GMT, places a cursor over the Hours value on the time display. The value can then be increased or decreased by moving the joystick up or down. Pushing the joystick to the right then moves the cursor to the Minutes value. Similarly, the cursor can be moved back to Hours by moving the joystick left. When the time is adjusted, the information will only be saved if you press Key 1 SET.

Pressing Key 4 puts a cursor over the Day entry of the Date. The date is adjusted in the same way as time. With the cursor over the Month when the joystick is moved up or down, the first three characters of each month are scrolled together i.e. JAN, FEB, MAR, APR etc. Only after pressing Key 1 SET is the new date saved. The Time and Date will be automatically corrected as soon as the first satellite reaches TA (time available) status. If any satellite is at status TA or above, user inputs of time and date will be ignored.

Setting Local Time Offset



Screen 5: Local Time Offset Screen

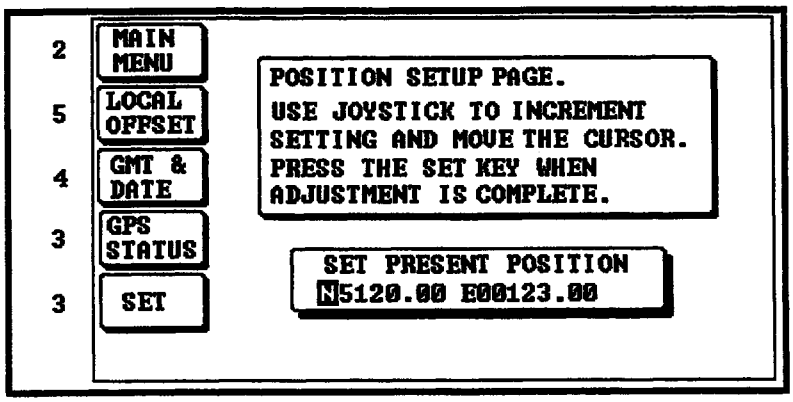
This Screen is accessed by pressing GPS STATUS in Main Menu, followed by LOCAL OFFSET. When this Screen initially appears a cursor is positioned over the hours value. This value can be adjusted between the limits of +12 and -12 by moving the joystick up and down. The cursor can be

moved to the right to adjust the minutes to one of two values, 00 or 30. Only after pressing Key 1 SET is the information saved and the display reverts to Screen 3.

The local offset is held in RAM and added to GMT time when calculating ETAs. Default value is +00:00. **It is important to set local offset correctly to ensure ETAs given in Nav Mode are correct.**

Keys 3 and 4 give direct access to Screen 4 for Time and Date adjustment.

Setting Present Position



Screen 6: Present Position Setup Screen

This Screen is accessed by pressing GPS STATUS in Main Menu, followed by SET POSN. On entry to this Screen a cursor is positioned over the first character of the latitude as shown above. The joystick can then be used to increment or decrement values and to move the cursor right and left.

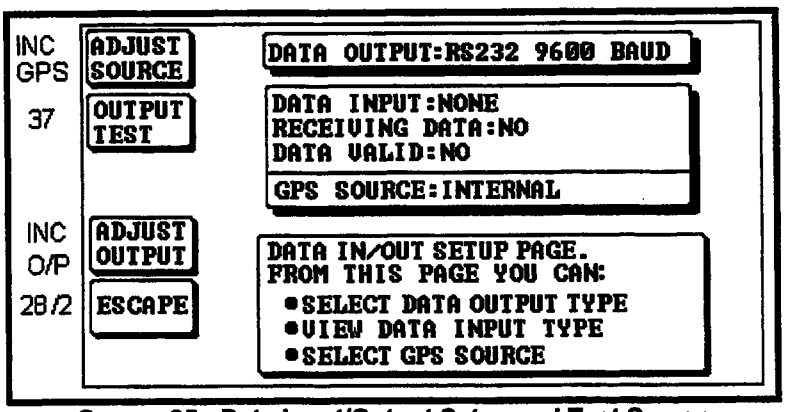
When new values for latitude and longitude have been selected, pressing Key 1 SET will enter the new latitude and longitude and revert to Screen 3. If the unit is receiving sufficient satellite signals to calculate a fix, user-entered latitude and longitude will be ignored. Keys 3 & 4 give direct access to Time and Date adjustment.

DATA INPUT (Colour Tracker only)

Colour Tracker has no internal GPS receiver and so requires a data input from a separate GPS or LORAN unit in order to function in Map Mode.

To operate correctly Colour Tracker requires a 4800 or 9600 baud NMEA 0183 data sentence containing latitude, longitude, track, and ground speed information. This can take the form of a single RMC sentence or a combination of GGA and VTG sentences. Alternatively a 9600 baud Trimble TNL, Garmin AIU or King equivalent ARNAV R-30 sentence may be used. Refer to the Installation Manual for connection information.

If your GPS or LORAN is correctly connected, switched on and outputting data, your Colour Tracker will automatically start to read and decode the incoming data. There is no need to set an input type on the Colour Tracker as this is done automatically. To see what is happening select Key 1, DATA IN/OUT, from the Main Menu Page and Screen 35 will be displayed.



Screen 35: Data Input/Output Setup and Test Screen

After a few seconds if data is being received, the word YES will appear next to the RECEIVING DATA: heading on Screen 35. The type of data being received will then be displayed beside the DATA INPUT: heading. The data type will be stored in NVM so that next time the unit is used the correct data input format is automatically set up. If you subsequently change your GPS or LORAN type, don't worry, your Colour Tracker will automatically readjust to the new data type.

If the data being received contains valid fix information (i.e. your GPS or LORAN has a fix) the word YES will appear next to the DATA VALID: heading. Once the unit is receiving and validating the incoming data you are ready to navigate using Colour Tracker's advanced features.

Press Key 1 to return to the Main Menu Screen.

FLIGHT PLANNING SCREENS

In order to allow you to navigate along pre-planned routes, your Skyforce equipment has facilities to memorise up to 500 user waypoints. Using these waypoints together with the enormous built-in database you can then plan up to 99 routes. The maximum length of each route is limited only by the total number of routes stored. The equipment has a capacity to store up to 500 route points with a maximum number of waypoints in any one route of 99.

For example, you can program 99 routes, each with 5 turning points making a total of just under 500 route turning points or you could program 5 routes each with 99 turning points. If you attempt to exceed 500 turning points the unit will display a ROUTES FULL message.

For simple single-leg navigation there is a useful DIRECT TO or GOTO navigation mode. This allows you to fly from your present position directly to any point in the world. More details about this function are discussed later in this Manual.

All waypoints and routes are normally programmed before embarking on the trip and stored in the unit's waypoint and route library.

Waypoints

A waypoint is a specific location anywhere in the world, defined by a name of up to nine letters or numbers and by its latitude and longitude. In your new Skyforce equipment there are three types of user-defined waypoints, each with a specific function.

Basic Waypoints are purely user-defined points. These are used to build routes for conventional waypoint navigation or simply to add personalised points to your map.

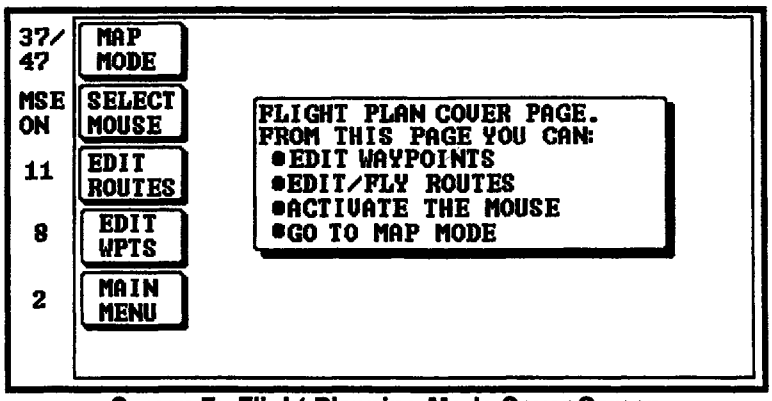
Marker Waypoints are also user-defined waypoints. These can be configured to act as alarm trigger markers. For example, say you are flying a route and you know you have to make a radio call or initiate a climb at a specific point. A Marker Waypoint can be positioned at that location (but not included in the route) and be set up to trigger an alarm. If a waypoint is to be used as an alarm trigger, when it is programmed it is given the name **MARKERX.X.** The word MARKER here specifies to the software that this waypoint is to be used as a marker point only and that no name is to be printed next to the waypoint icon on the map. The X.X specifies the alarm trigger range between 0.1nm and 9.9nm. The default is 1.0nm. A circle of the specified radius will appear around the marker point on the map.

While the Skyforce software is searching to locate the nearest items for conventional position reporting, if it pulls up a waypoint named MARKERX.X, it will continuously compare the distance from the present position to the Marker Waypoint with the value X.X. When the distance to the Marker becomes less than or equal to X.X then an audible alarm will be triggered. A box will also appear at the top of the screen showing MARKER IMMINENT. Key 5 will change to ALARM OFF and when pressed, will silence the audio alarm and remove the MARKER IMMINENT message.

Should you wish a Marker Waypoint to have a name next to it for reference, you simply program a Basic Waypoint with the same co-ordinates as the Marker and give this one a conventional name. The Basic and Marker Waypoint icons would then be superimposed on each other, resulting in a single, named Marker Waypoint.

User Defined Airfields. Owing to the fact that many private and unlicensed airfields are not included within the Jeppesen database contained within your unit, you have the opportunity to program up to 25 of your own USER DEFINED AIRFIELDS. Waypoints numbered 101 - 125 have been reserved for this purpose and whenever any of these is selected for editing on Screen 8, Waypoint Viewer Screen, Screen 8a will be displayed instead. This Screen allows the insertion of additional information so permitting 25 waypoints to become user-defined airfields. These will be shown on the map pages with an airfield icon instead of a waypoint icon. The user-defined airfields will also be included in the ten nearest fields search on Screen 43, Ten Nearest Airfields Screen, and will receive equal priority with other database airfields for position reporting purposes.

On Screens 39, Map Mode with Joystick Active Screen, and 40, Map Mode Airfield Info Screen, if the pointer is placed over a user-defined airfield and the MORE INFO Key is pressed, the information you have programmed in will be displayed.



Screen 7: Flight Planning Mode Cover Screen

Key 1 returns to Main Menu.

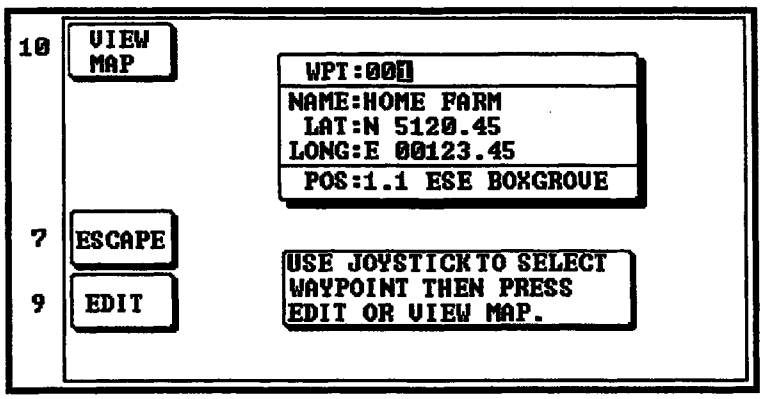
Key 2, EDIT WPTS, gives access to waypoint creation and editing pages.

Key 3, EDIT ROUTES, gives access to route creation and editing pages.

Key 4 switches the mouse pointer on and allows the mouse to replace joystick functions. When Key 4 is pressed its label becomes MOUSE OFF, pressing again will switch the mouse off. The mouse will also be automatically switched off if Key 1 or Key 5 is pressed.

Key 5 gives direct access to the current Map Mode.

Viewing Waypoints



Screen 8: Waypoint Viewer Screen

This Screen is accessed by pressing FLIGHT PLAN in Main Menu, followed by EDIT WPTS. When this Screen appears a cursor will be seen positioned over the waypoint number. Moving the joystick up and down increments or decrements the waypoint number. (Holding the joystick up or down will increase the speed of these changes.) If the joystick is moved to the left, the cursor will move to the left allowing rapid access to high numbers.

As each waypoint number is selected, the name, latitude, longitude and position fields are updated. Empty waypoints will be shown with asterisk characters in the latitude and longitude fields.

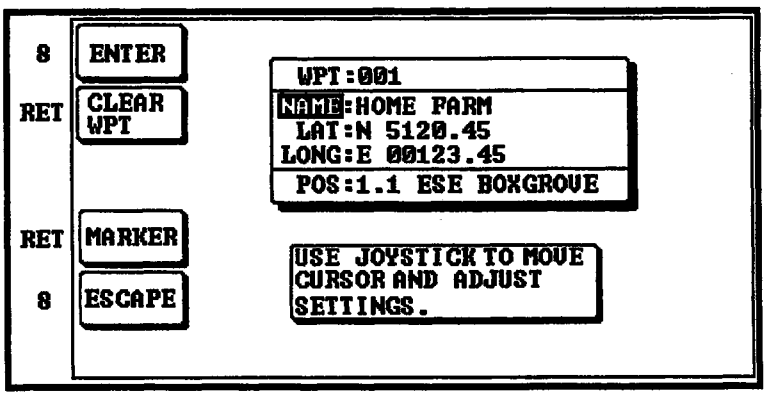
As each waypoint is selected, all stored routes are automatically checked to see if that waypoint is being used in any current route. If the waypoint is found within any of the routes, the words [ROUTE LINK] will be printed next to the waypoint number. It is necessary to think carefully before editing any waypoint marked ROUTE LINK since any changes you make to the waypoint are liable also to affect one or more of the programmed routes.

If a waypoint marked ROUTE LINK is selected for editing and the **Name only** is changed, the new name will be copied over to the relevant parts of the route list. If the name is left the same and the **Latitude and/or Longitude only** is changed, the new details will also be copied into the route list. However, if the **Name** is changed, **along with either the Lat or Long** the waypoint will be treated as completely new and the details **will not** be copied to the route list.

This would result in your being left with turning points in your routes that do not exist as waypoints. This can be beneficial in some cases as it makes it possible to double the number of user points in the system to 1000, but it is essential to understand this feature thoroughly and to use it carefully.

Once a waypoint has been selected, Key 1 gives access to the Manual Waypoint Editing facilities. Key 2 will return to the main Flight Planning Mode Cover Screen. Key 5 displays Screen 10 which is the Graphical Waypoint Editing Screen. This shows a map on which the selected waypoint is central. If the selected waypoint is empty, the map will default to the last fix position.

Manual Waypoint Editing



Screen 9: Manual Waypoint Edit Screen

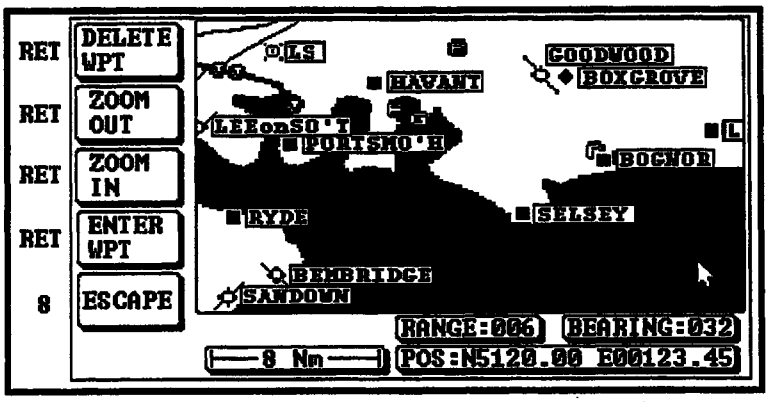
This Screen is accessed by pressing FLIGHT PLAN in Main Menu, followed by EDIT WPTS and EDIT. On entry to this Screen a cursor appears over the word NAME. The cursor can be moved up and down between NAME, LAT and LONG using the joystick. The joystick is again used to move the cursor to the right so that the waypoint name, lat and long can be entered or amended, again by using the joystick.

When the cursor is moved to the right after the last character in a line, the cursor will move to the next line heading. i.e. from the last character in the name, the cursor will go to the word LAT and similarly from the last digit of the longitude it will go to the word NAME.

If you want to use the selected waypoint as a marker as described previously, pressing Key 2, MARKER, will automatically write the word MARKER1.0 into the name field to save you the time of spelling the word out in full. You can then move the cursor across using the joystick and alter the range and fill in the latitude and longitude. If you want to delete an existing waypoint, press Key 4.

When the desired alterations have all been made, touching Key 5 will enter the revised data and return you to Screen 8, Waypoint Viewer Screen. Alternatively, touching Key 1 will return you to Screen 8 without modifying the waypoint information.

Graphical Waypoint Editing



Screen 10: View and Edit Waypoints on the Map Screen

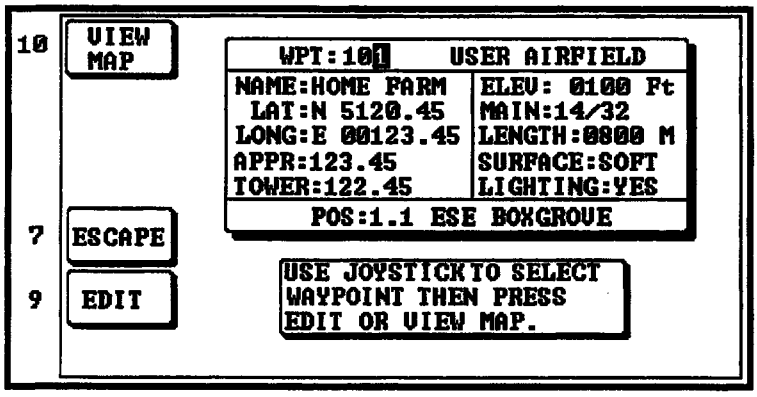
When this Screen first appears, after pressing VIEW MAP on Screen 8, Waypoint Viewer Screen, the selected waypoint will be centrally positioned. The joystick or mouse, if selected, can be used to move the pointer. The screen window can be moved around to display other areas of the map by "bumping" the screen borders left, right, up or down with the pointer. If you need to "bump" the screen over a large distance you will find it quicker and easier to zoom out first, move across the map as required, then zoom back in. (In order to make these moves swiftly, not all details of the map are shown on screen until the joystick is released.)

Range and bearing boxes below the map show range and bearing from the selected waypoint (or the last waypoint entered) to the pointer. This feature allows you easily to enter new waypoints as a range and bearing from a previously entered waypoint.

New waypoints can be created wherever the pointer is placed simply by pressing Key 2 (or the left hand mouse button). Existing waypoints can be deleted by positioning the pointer directly over them and then pressing Key 5 (or the right hand mouse button). Should you attempt to delete a waypoint that is being used in a stored route, the [PRESENT IN ROUTE] message box will be displayed and the waypoint will NOT be deleted. Pressing Key 5 (or the right mouse button) a second time **will** then delete the waypoint.

Each new waypoint graphically created on the map will automatically be given the next available waypoint number as a temporary name but you can alter this name later by using Screen 9, Manual Waypoint Edit Screen.

Editing User Airfields

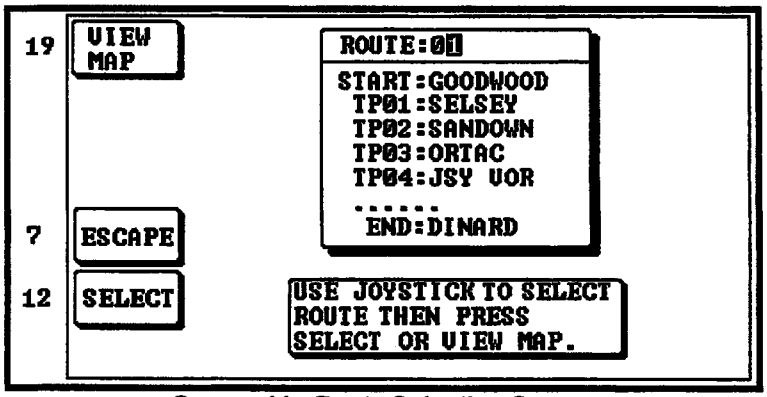


Screen 8A: User Airfield Edit Screen

Whenever you select a waypoint number between 101 and 125 in Screen 8, Waypoint Viewer Screen, Screen 8A, User Airfield Edit Screen, will be displayed. This is similar to Screen 8 but contains fields where you can enter and store additional information about the airfield's main runway and frequencies.

Routes

The route function allows you to store up to 99 routes, as explained earlier in this section. These routes can be recalled from memory and flown in Nav Mode. You can choose to use as turning points any waypoints from the built-in database (which is subdivided and arranged alphabetically) and also, if you wish, from your own list of user-defined waypoints.



Screen 11: Route Selection Screen

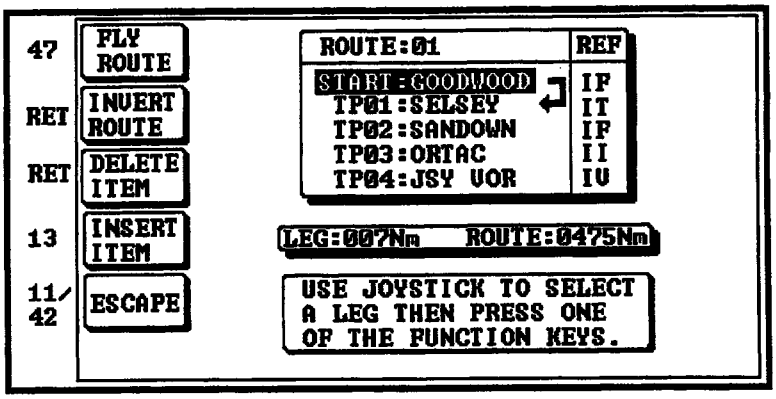
This Screen is accessed by pressing FLIGHT PLAN in Main Menu, followed by EDIT ROUTES. As you enter this Screen you will find a cursor positioned over the route number. The first few items of the selected route are displayed in the box under the route number together with the final (destination) item. You can then use the joystick to select other routes. Use the same technique as was described earlier for selecting waypoint numbers. You can select any one of 99 routes for manual editing by pressing Key 1.

Key 2 returns you to the Flight Planning Mode Cover Screen. Key 5 calls Screen 19, enabling you to see the selected route graphically on the map.

If you happen to access the above Route Selection Screen while a route is active and you subsequently dial up the active route number, you will find Key 5 changes to ROUTE OFF and Key 1 goes blank. As a safety measure the system will not allow you to edit the active route directly, or

indirectly by deleting a waypoint that is present in it, unless you touch Key 5, ROUTE OFF. This will switch the route out of active status and re-enable Key 1 allowing you to edit what was until then the active route.

Manual Route Building and Editing



Screen 12: Route Program/Edit Screen

This Screen can be accessed either from through Flight Planning Mode Cover Screen (by pressing FLIGHT PLAN in Main Menu followed by EDIT ROUTES and SELECT) or through the Nav Menu Cover Screen (by pressing NAV MENU in Map Mode followed by SELECT ROUTE). See Screen 41, Nav Menu Cover Screen for more information.

When you enter this Screen you will find a cursor positioned over the first item in the chosen route. By using the joystick, you can move the cursor up or down. This enables you to scroll in either direction through the entire route in the display box.

Next to each turning point in the column headed REF you will see a two-character code which gives the database origin of each point in the route. The meanings of these codes are as follows:

IF (Internal Jeppesen AirFields), IV (Internal Jeppesen VORs), IN (Internal Jeppesen NDBs), IR (Internal Jeppesen Runways), IT (Internal Skyforce Towns), II (Internal Jeppesen Intersections/Approach Waypoints), WP (current user Waypoint {if waypoint link is present}), OW (Old user Waypoint {if waypoint link has been broken}), UA (User Airfield {waypoint numbers 101-125}) and PC (external data down loaded from a PC).

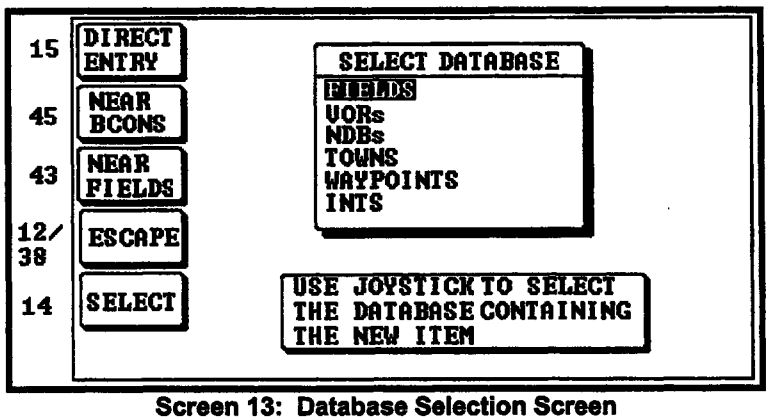
In the example shown in the illustration for Screen 12, moving the joystick down would move the cursor down over TP01 but would leave the "LEG" arrow positioned as it was. The distance shown next to the word LEG also would remain unchanged, showing the leg distance from the route start point to turning point 01 (TP01). Moving the joystick down again would move the cursor down to TP02, move the leg arrow down so that it is pointing between TP01 and TP02 and the figures next to the word LEG would then show the distance from TP01 to TP02 and so on. The number next to the word ROUTE is the total route length from start to finish.

An extra waypoint can be inserted at any place in the route (assuming the route is not full). To do this, you position the cursor over the appropriate point in the route and touch Key 2, INSERT ITEM. For example, if you placed the cursor over TP02, the new item would become TP02 and the existing TP02 would become TP03, etc. In a similar manner items may be deleted from the route by positioning the cursor and pressing Key 3, DELETE ITEM. Key 4 inverts or reverses the route. Key 5 throws the unit into Map Mode (Screen 47) with the selected route active. Key 5 also switches the mouse off (if it is on).

Manually Inserting a Turning Point into a Route and Manual GOTO

A turning point can be inserted into a route by using a two step process which is started by pressing Key 2 INSERT ITEM. The same process is followed when Key 5 GOTO is selected in Screen 38, Map Mode when joystick is not active. The GOTO function can also be used to obtain information on a particular aeronautical data point by following the same process described below and using the MORE INFO key on Screen 16. In this case the user does not wish to GOTO the selected item and therefore simply needs to use the ESCAPE key to return back to the original page.

Step 1. Selecting data source



Screen 13: Database Selection Screen

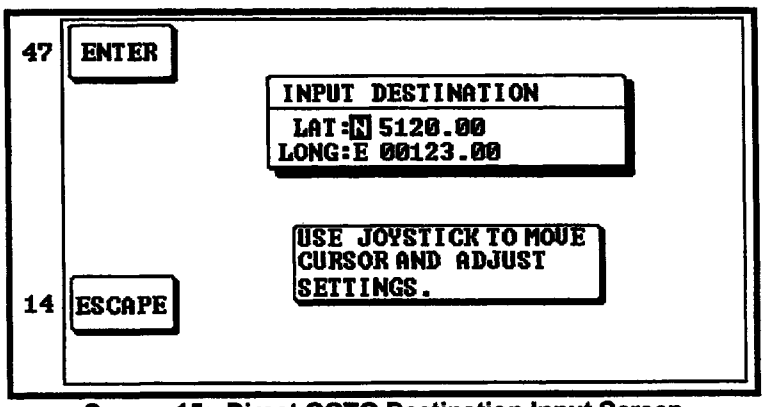
This Screen shows a list of data libraries and you will find a cursor positioned over the word FIELDS. You can use the joystick to move the cursor up and down the list of databases. Key 5, DIRECT ENTRY, only appears if this Screen is called from Screen 38 Map Mode.

By moving the cursor you select the database that contains the item you are looking for, whether to insert into your route or to use as a GOTO destination. Once you have the cursor over the correct database, touching Key 1 will move you onto the next selection process.

Key 3, NEAR FIELDS and Key 4, Near BCONS, only appear if this Screen has been entered after performing a GOTO in Screen 38, Map Mode. For more information on the function of these keys please refer to the Ten Nearest under the Nav Menu Screens Section.

Key 5, DIRECT ENTRY, only appears if this Screen has been entered from Screen 38. If you press Key 5, this will take you to Screen 15 (see below) which allows you to enter a direct GOTO point.

If Key 2 is pressed to discontinue the selection process the unit will return to whichever the previous Screen was, either Screen 12, Route Program/Edit Screen, or Screen 38, Map Mode.

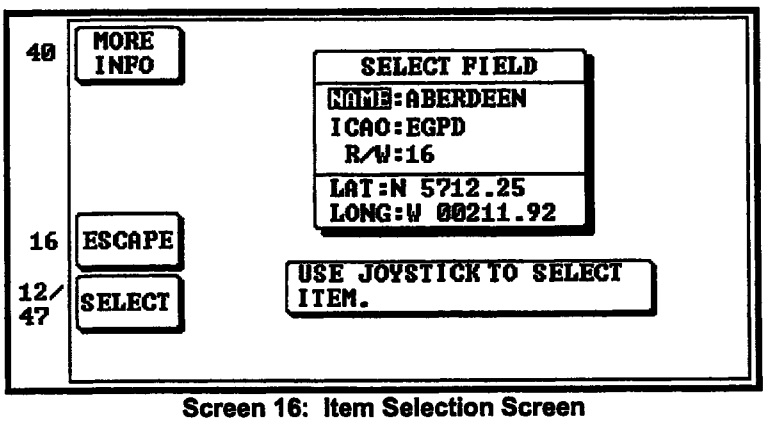


Screen 15: Direct GOTO Destination Input Screen

This Screen allows you to select a GOTO to a specific latitude and longitude, and is reached by pressing Key 5 Direct Entry on Screen 13.

Use the joystick to enter the latitude and longitude of the destination then press Key 2 ENTER and Screen 47, Map Mode with Navigation Information, will appear with GOTO OFF on Key 5.

Step 2. Selecting item from chosen database



Screen 16: Item Selection Screen

On entry to this Screen you will find the cursor positioned over the first letter of the first item in the selected database.

If FIELDS was selected on Screen 13 the cursor will be positioned over the word NAME:. Airfields may be selected by name or ICAO code and in addition, once an airfield has been selected, a particular runway threshold at that airfield can be selected. If you wish to select an airfield by ICAO code, use the joystick to move the cursor down to ICAO then right to the first character. If you wish to select a specific runway threshold, move the cursor down to R/W then right to the word NONE. Moving the joystick up or down will now allow you to select a specific runway threshold (if threshold information is available for that airfield in the Jeppesen database).

When selecting names, use the joystick to scroll the initial letters through the alphabet. Once the required initial letter has been selected, move the joystick to the right and repeat the process. In this way you can scroll through all the items from the selected database, narrowing your search field. If you move the joystick to the left, the cursor will also move left one step, allowing you to make another selection.

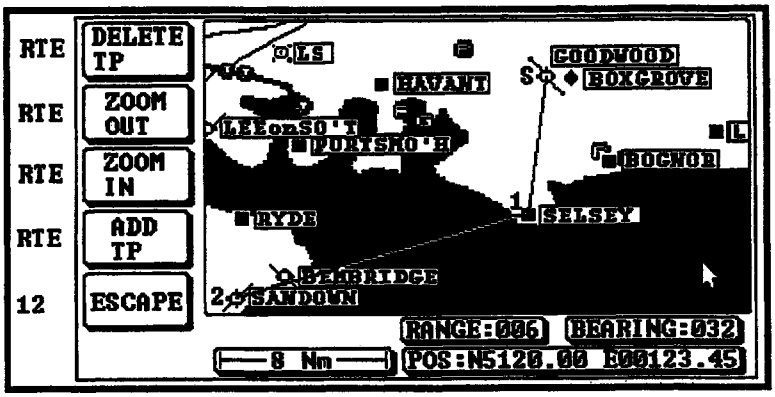
When an airfield is selected but no runway, the entry into your route will be the airfield's full name. When a runway is selected, the entry into your route will be the airfield's ICAO code followed by the runway ident. For example, if you select runway 32L at Goodwood, the entry to your route would be EGHR 32L.

On this Screen, KEY 5 labelled MORE INFO gives additional information about the selected item.

Once you have reached the desired item, touching Key 1 will select it and either return you to Screen 12, entering the item to your route or invoke the GOTO and take you to Screen 47, depending on which entry route to Screen 13 you happen to have used.

If VORs, NDBs or intersections/approach waypoints were selected on Screen 13, Database Selection Screen, you will see a 2 letter ICAO area code displayed to the right of the identifier. **When selecting a beacon, intersection or approach waypoint, check the ICAO area code carefully since there are duplicates present in the database. Checking the area code will eliminate any ambiguity.**

Graphical Viewing and Editing of Routes



Screen 19: View and Edit Routes On Map Screen

This Screen is selected by pressing Key 5 View Map on Screen 11, Route Selection Screen, and will be displayed showing the starting point of the selected route centred in the middle of the display. The legs and turning points will be shown as in the illustration above.

The joystick or mouse, if selected, can be used to move the pointer. The screen window can be moved around the map by "bumping" the screen borders left, right, up or down with the pointer. **Range and bearing boxes below the map show range and bearing from the last waypoint in the route to the pointer.** This feature allows you to enter turning points as a range and bearing from the previous route point.

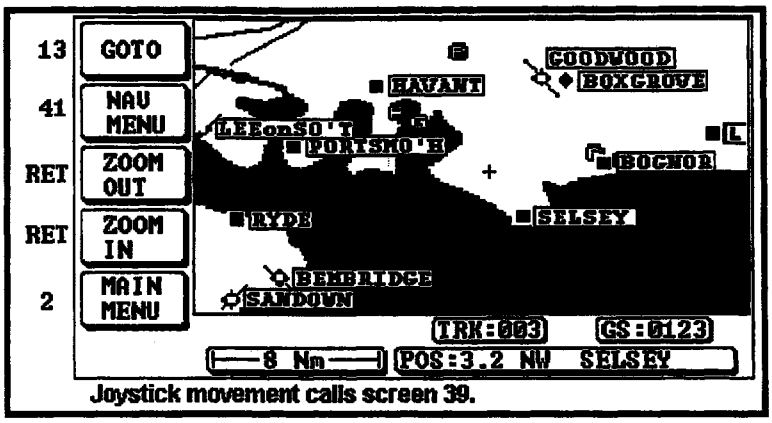
To build a route you simply point at the item to be included in the route and press Key 2, ADD TP, or the left mouse button. If a turning point is required that does not exist as a built-in data point or waypoint, all you need do is move the pointer to the desired position and press Key 2 or the left mouse button. If the unit can find no built-in data point in memory, it will create and insert a new waypoint which you can later name by using Screen 9.

To delete a turning point from a route, point at the item you wish to remove and press Key 5 or the right mouse button. To delete a newly-created user defined waypoint, you have to return to Screen 9, Manual Waypoint Edit Screen, or 10, View and Edit Waypoints on the Map Screen. You can create waypoints on Screen 19 but not delete them from there.

New waypoints can be entered anywhere within an existing route. You simply move the pointer over the leg into which the waypoint is to be added and press Key 2, ADD TP, or the left hand mouse button. If, for example you wanted to add BOGNOR to the route going from GOODWOOD to SELSEY shown in the illustration above, you would first position the pointer over the track line between Goodwood and Selsey and press Key 2 or the left mouse button. You would then move the pointer, stretching the track line like a rubber band, until it was over BOGNOR and press Key 2 or the left mouse button again. The new track line would then be set joining GOODWOOD to BOGNOR to SELSEY and the TP numbers shown next to SELSEY and all subsequent turning points would be increased by one. Bognor would become TP01, Selsey TP02 etc.

If you need to extend a route by adding an extra waypoint to the beginning or end of an existing route, simply move the pointer until it is near the first or last waypoint in the route and press Key 2 or the left mouse button. Next move the pointer until it is over the waypoint you want to use as your new start or destination and press Key 2 or the left mouse button again.

MAP MODE SCREENS



Screen 38: Basic Map Mode Screen

This Screen is accessed by pressing MAP MODE in Main Menu. When you enter this Screen, if the Colour Skymap's internal GPS receiver has been able to establish a fix or if the external GPS you are using to feed your Colour Tracker is sending valid data, a Screen similar to the above will be displayed. The map is initially displayed at the Zoom Level where the Scale Bar represents 8nm. This is approximately the same scale as a 1:500,000 chart. If there is no valid GPS fix data available, the map box will show the last valid position and the words NO FIX POSSIBLE will be shown across the centre in a box. If later the fix is lost at any time after a map has been displayed, the same NO FIX POSSIBLE box will be overlaid on the map.

The map will be shown in either North Up mode or Track Up mode depending upon the setting you have made from Screen 22, Map Customisation Screen. The map will be updated every second. From this page, if you press Key 1, Screen 2 Main Menu will take its place. You can use Keys 2 and 3 at any time to zoom the map in and out to whichever one of the 12 preset scales you wish to use. The levels of detail appearing at each zoom level can be selected on Screen 22 as described in the Setup Screens Section later.

The small boxes marked TRK: and GS: display your present track and ground speed. Ground speed is displayed in the units selected on Screen 22, Map Customisation Screen. Track will be magnetic with local variation automatically taken into account.

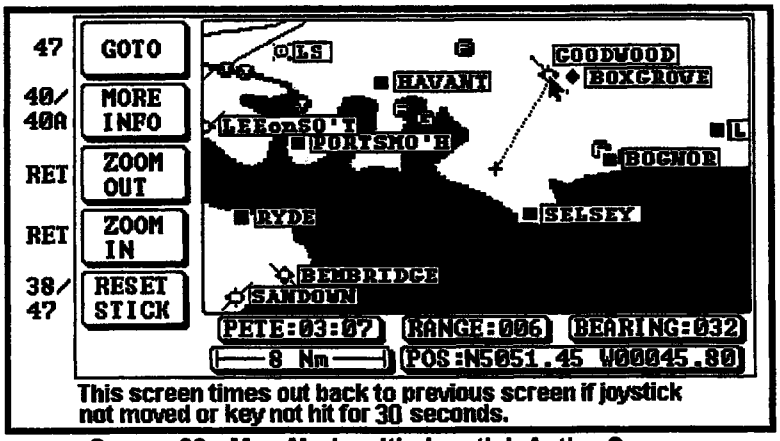
The box marked POS: will display your present position as a range and cardinal bearing from the nearest item in the database. The geographical item used to describe your position to you is chosen on the basis of a table of priorities. If your position is within five miles of an airfield, it is your range and bearing from that airfield that will be displayed, even if there is a beacon or town nearer. **All airfield names are shown preceded by a * in order to distinguish them from towns with similar names which may have significantly different locations.** If your position is found to be within five miles of a VOR beacon and more than five miles from an airfield, then your position will be shown with respect to the VOR beacon, even if there is a user waypoint, NDB or town nearer. User waypoints have next priority followed by NDBs and towns last.

At the bottom left hand corner of the display you will also see a Scale Bar showing a measurement. The measurement may be in nautical miles, statute miles or kilometres depending on the map units which you have selected from Screen 22., Map Customisation Screen.

Pressing Key 4 will take you to Screen 41, the Nav Menu Cover Screen.
Pressing Key 5 will take you to Screen 13 from which you can select a GOTO destination.

Under normal circumstances, you will not see any joystick pointer on Screen 38. However, if you do move the joystick, a pointer will appear just beside your present position icon and the display will change to Screen 39.

Data Interrogation and Graphical GOTO



Screen 39: Map Mode with Joystick Active Screen

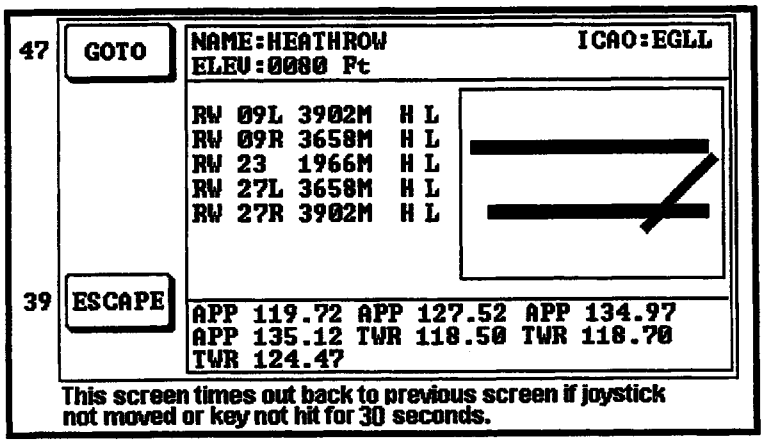
As soon as you move the joystick while in Screen 38, Map Mode, a Screen similar to the above Screen 39 will be displayed. The map freezes in its present position with respect to the joystick pointer and the symbol indicating your present position starts to move across the Screen. A line appears between present position and the joystick pointer. (The reason the map is made to stop moving is that this makes accurate positioning of the joystick pointer much easier for you.)

Simultaneously, you will see the TRK and GS boxes have now changed to RANGE, BEARING and PETE (Pointer ETE). These now show the range and bearing **from** present position **to** the joystick pointer and the pointer estimated time enroute (PETE). The PETE is calculated on present GS and would read 00:00 if you were stationary. You can use this function to measure range, bearing and estimated time enroute to any point on the map. The window formed by the extremities of the Screen can be moved around the map by "bumping" the Screen borders left, right, up or down with the pointer. You can still use Keys 2 and 3 to zoom the map in and out. When you are finished using this Screen press Key 1, RESET STICK, and the joystick pointer will vanish, your display will return to Screen 38 and the map will be placed back in its present position. If you don't move the joystick for 30 seconds, this will have the same effect as pressing Key 1.

In addition to finding it useful for measuring ranges, bearings and ETEs, you can utilise this Screen for other tasks. If you place the pointer over an airfield or a beacon (VOR or NDB) and then press Key 4, MORE INFO, Screen 40 (Airfield) or Screen 40A (Beacon) as illustrated below will appear. These Screens contain additional data and information about the item you selected.

If you want to navigate directly to any position, press Key 5 and you will obtain a direct GOTO, taking you to wherever the pointer is positioned, even if it is not pointing to a database item. This is a very useful feature for arbitrary in-flight diversions. After you have pressed Key 5, GOTO, Screen 47, Map Mode with Nav Info, appears, with Key 5 now labelled "GOTO OFF".

Airfield Information


47
GOTO
NAME:HEATHROW
ICAO:EGLL
ELEV:0000 Ft
RW 09L 3902M H L
RW 09R 3658M H L
RW 23 1966M H L
RW 27L 3658M H L
RW 27R 3902M H L
39
ESCAPE
APP 119.72 APP 127.52 APP 134.97
APP 135.12 TWR 118.50 TWR 118.70
TWR 124.47
This screen times out back to previous screen if joystick not moved or key not hit for 30 seconds.

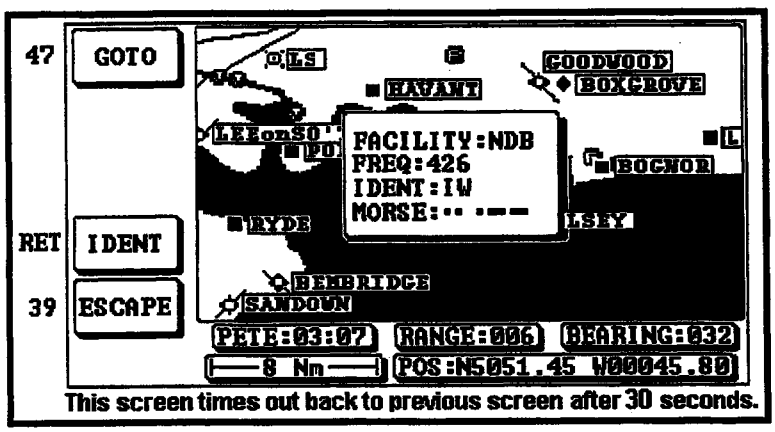
Screen 40: Map Mode Airfield Info Screen

As explained above, you can access this Screen from Screen 39 by placing the joystick pointer over an airfield icon and pressing Key 4. All the information given here is derived from the built-in Jeppesen database. Runway surfaces are shown as an H for hard and an S for soft. Lighting is shown as an L for lit and a U for unlit.

To obtain direct GOTO for the chosen airfield all you have to do is press Key 5, labelled GOTO.

To return to the Map of Screen 39 you should press Key 1. Alternatively, the unit gives you 30 seconds to read what you require from the Info Screen and then automatically returns to Screen 39.

Beacon Information



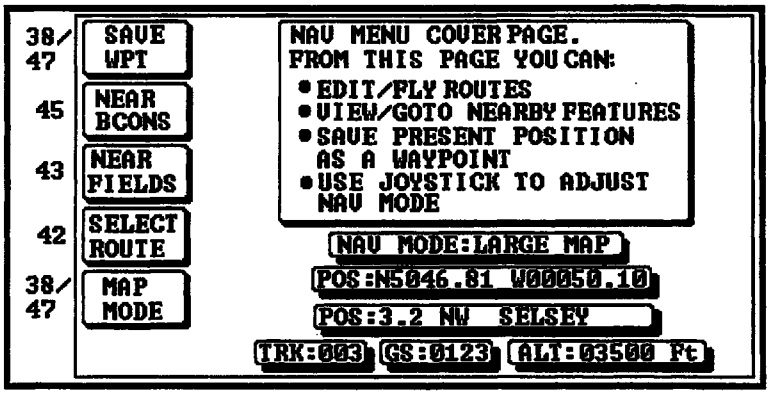
Screen 40A: Map Mode Beacon Information Screen

As explained above, you can access this Screen from Screen 39 by placing the joystick pointer over a VOR or NDB icon and pressing Key 4. Full details of the Beacon are listed, type, frequency and ident. The fourth line in the box is a visual representation of the Morse ident and if you are one of those pilots whose knowledge of Morse is less than perfect, all you have to do is press Key 2, IDENT, and the unit will bleep out the correct ident (on its internal bleeper and into your headset if the intercom connection has been made during installation). You can then compare this to the ident you are hearing over the radio to verify that you are indeed tuned to the beacon you want.

To obtain direct GOTO for the chosen Beacon (VOR or NDB) all you have to do is press Key 5, labelled GOTO.

To return to the Map of Screen 39 you should press Key 1. Alternatively, the unit gives you 30 seconds to read what you require and then automatically returns to Screen 39.

NAV MENU SCREENS



Screen 41: Nav Menu Cover Screen

You can enter this important Screen by pressing Key 4, NAV MENU, while in Map Mode (on Screen 38 or 47). It is a versatile Screen with several useful functions.

If you move the joystick up or down when in this Section, the screen layout presented when in NAV MODE can be selected to be either LARGE MAP/LARGE TEXT/HSI. Please refer to the Nav Mode Setup in the Setup Screens Section of this Manual.

If you wish to return to your previous Map Mode Screen at any time, press Key 1.

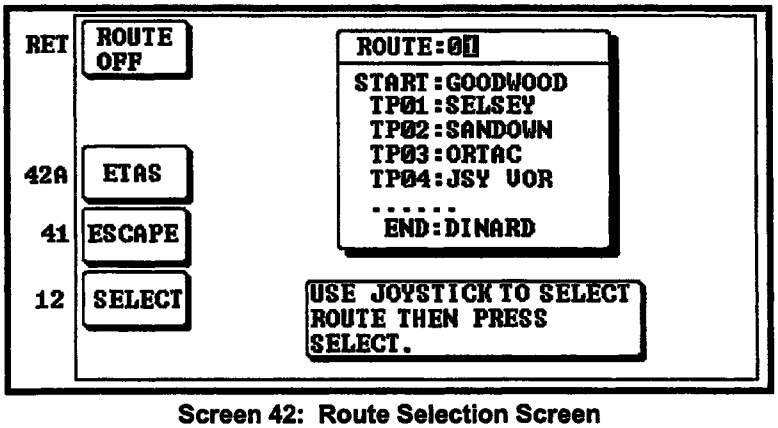
Key 2, SELECT ROUTE, gives you direct access to Flight Planning Mode where you can manually select, cancel and edit routes as required.

If you press Key 3, NEAR FIELDS, you will be presented with Screen 43, Ten Nearest Airfields Screen, on which you can read off the ten airfields nearest to your present position.

If you press Key 4, NEAR BCONS, you will see Screen 45, Ten Nearest Beacons Screen, giving you details of the ten VORs and NDBs nearest to you. For more information on Screens 43 and 45 refer to the Ten Nearest Section of this Manual.

If you wish to save your present position, press Key 5, SAVE WPT, and your co-ordinates will be saved as the next available waypoint number. Once the waypoint has been saved, the Screen will revert to Map Mode (Screen 38 or 47) where the new waypoint will already feature on the map.

Selecting a Route



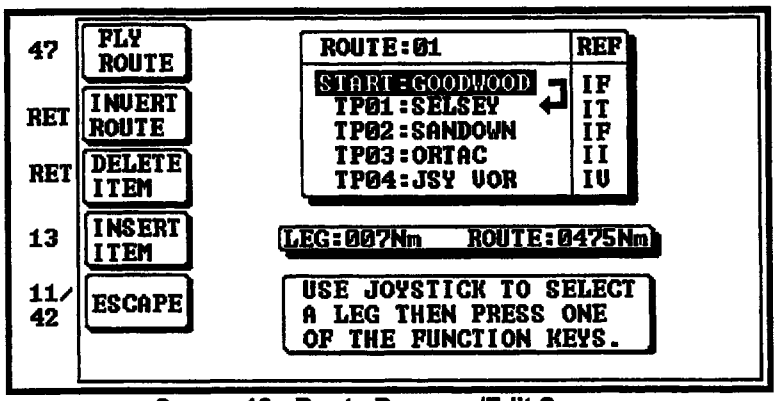
Screen 42: Route Selection Screen

This Screen is entered by pressing Key 2, Select Route, on Screen 41, Nav Menu Cover Screen. On entry to this Screen you will see a cursor positioned over Route Number 01, or if there is a route already active, its number will be shown instead of Route 01. You will see the first few items of the selected route together with its final destination in the box under the Route Number. You can select any route you want by using the joystick to scroll the route number up or down. You are free to select any one of the 99 available routes. If you wish to return to the Nav Menu Cover Screen (Screen 41) press the ESCAPE Key 2.

If the selected route is already running, Key 5 will read ROUTE OFF, Key 1 will be blank and Key 3 will read ETAS. If the selected route is not active, Key 3 and Key 5 will be blank and Key 1 will read SELECT. The active route can be switched off at any time by pressing Key 5.

Pressing Key 5 will cancel the active route and allow you gain access to what was the active route. (In the interests of safety, the software has been designed not to permit you to edit and fly a route at the same time.)

Pressing Key 3 will allow you to view the ETAS for each leg of the active route. The current destination waypoint in the active route is shown highlighted. ETAs are calculated both forward and backward along the route from the present position.

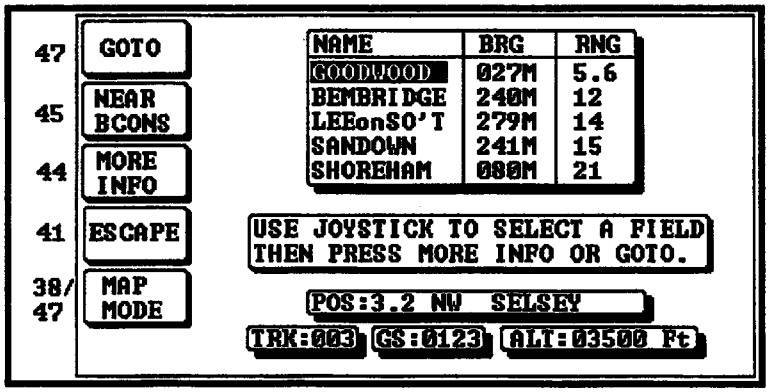


Screen 12: Route Program/Edit Screen

In order to select a route to fly, bring up the desired Route Number with the joystick and press Key 1, SELECT, in Screen 42, Route Selection Screen. This will call Screen 12 from which you can choose to edit the route, reverse the route or activate the route. In order to activate the route, simply use the joystick to select the desired leg then press Key 5, FLY ROUTE. (If you have activated AUTO LEG SELECT on Screen 23, Nav Mode Customisation Screen, the nearest leg to your present position will automatically be selected for you as soon as you enter Screen 12.)

Ten Nearest

Airfields

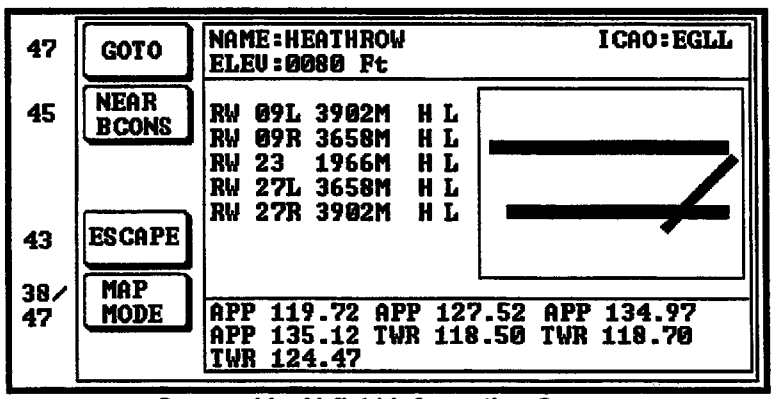


Screen 43: Ten Nearest Airfields Screen

This Screen is accessed by pressing Key 3, NEAR FIELDS, on Screen 41, Nav Menu Cover Screen. When this Screen appears you will find a cursor over the first airfield in the list. You can scroll up and down the list by using the joystick. Once the cursor is lying over the name of the airfield you require, if you press Key 3, MORE INFO, Screen 44 below will appear, giving you additional information about that airfield.

To obtain a direct GOTO for the chosen airfield all you have to do is press Key 5, labelled GOTO, and you will switch back to (Screen 47) Map Mode with the selected Goto activated.

Key 1 returns you to Map Mode ,Screen 38 or 47. Key 2 returns you to the Nav Menu Cover Screen (Screen 41). By pressing Key 4, NEAR BCONS, you can switch to Screen 45, Ten Nearest Beacons, giving information about the ten nearest beacons.

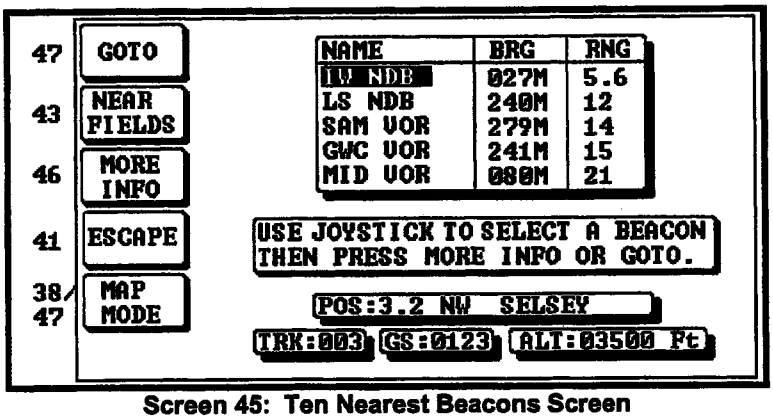


Screen 44: Airfield Information Screen

Once you have selected an airfield on Screen 43 and pressed Key 3, MORE INFO, the display will change to Screen 44 above. This gives additional information about runways, frequencies, elevation etc. for the airfield in question.

To return from this Screen to Map Mode (Screen 38 or 47) you simply press Key 1. To select another airfield from the Ten Nearest (Screen 43) you press Key 2 and if you want to see the list of ten nearest beacons, simply press Key 4 which will take you directly to Screen 45, Ten Nearest Beacons. To obtain a direct GOTO for the chosen airfield all you have to do is press Key 5, labelled GOTO, and you will switch back to (Screen 47) Map Mode with the selected Goto activated.

Beacons

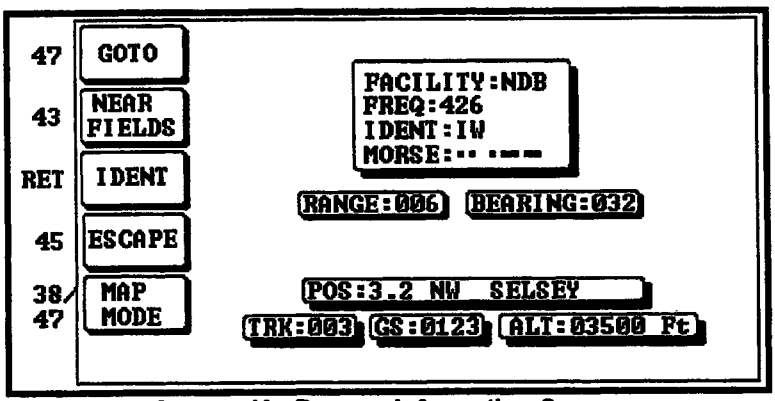


Screen 45: Ten Nearest Beacons Screen

This Screen is accessed by pressing Key 4, NEAR BCONS, on Screen 41, Nav Menu Cover Screen. On entry to this Screen you will find a cursor placed over the first beacon in the list. The list can be scrolled up and down using the joystick. Once you have placed the cursor over the name of the beacon you want, press Key 3, MORE INFO, to display Screen 46 below, which gives additional information about that beacon.

Pressing Key 1 will return you to Map Mode (Screen 38 or 47). Key 2 returns you to Screen 41, Nav Menu Cover Screen. A press on Key 4, NEAR FIELDS, will take you to Screen 43, giving you the list of the ten nearest fields.

To obtain a direct GOTO for the chosen beacon all you have to do is press Key 5, labelled GOTO, and you will switch back to (Screen 47) Map Mode with the selected Goto activated.



Screen 46: Beacon Information Screen

The Screen above shows the additional information about the beacon chosen on Screen 45, Ten Nearest Beacons.

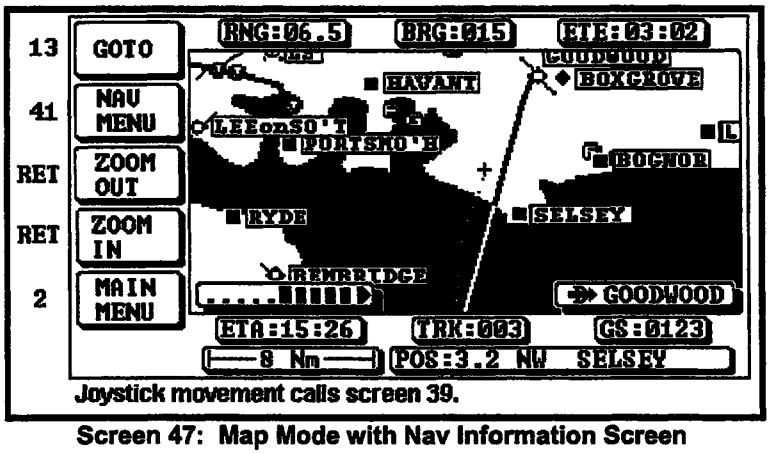
From here by pressing Key 1 you will get back to Map Mode (Screen 38 or 47). To select another beacon from the Ten Nearest (Screen 45) you press Key 2. If you press Key 3, IDENT, the unit will mimic the Morse Code ident for the chosen beacon on the internal beeper (and in your headset if you switched this on in Screen 23, Nav Mode Customisation Screen).

If you want to see the list of the ten nearest airfields, simply press Key 4 which will take you directly to Screen 43, Ten Nearest Airfields Screen.

To obtain a direct GOTO for the chosen beacon all you have to do is press Key 4, labelled GOTO, and you will switch back to (Screen 47) Map Mode with the selected Goto activated.

MAP MODE WITH NAV INFORMATION

Whenever a route is active or you have called for a GOTO, the map will have extra navigation information added to it and will resemble Screen 47 below. Alternatively you may have selected NAV MODE to be LARGE TEXT & MAP (Screen 47A) or HSI (Screen 47B) on Screen 23, Nav Mode Customisation Screen. The same navigation data is presented on these two alternative screens in different ways. The following text refers to the standard Nav Mode Screen setting (LARGE MAP). Alternative Screens 47A and 47B are discussed in the Nav Mode Setup Section of this Manual.



Screen 47: Map Mode with Nav Information Screen

The Course Deviation Indicator (CDI) at the bottom left of the map can be switched ON or OFF or be set to work numerically and the Full Scale Deflection (FSD) selected on Screen 23, Nav Mode Customisation Screen. If you have selected the CDI alarm ON, when the last element of the CDI bar graph comes on (or when the full scale value as set on Screen 23 is reached) the internal and external alarms (if switched on) will beep at a rate of 2Hz for 5 seconds.

Key 5 will change to ALARM OFF and if you press this before the 5 seconds are up this will silence the alarm. When the alarm switches off automatically after 5 seconds, Key 5's label will go blank and have no function for 2 seconds then revert to GOTO (or GOTO OFF). This is to make sure you don't inadvertently select or cancel GOTO mode if you press this Key just as it is cancelling automatically. The CDI alarm resets itself as soon as you come back within the full scale set. It will then be reactivated whenever the full scale is exceeded again.

The box at the bottom right of the map window shows the destination point when you are in GOTO Mode or the next waypoint when you are in Route Mode preceded by the "DIRECT TO" symbol.

A great deal of other navigation information is available to you above and below the map. (The positioning of this data that is described in the following relates to when the screen is in Landscape Mode. The position of some of the items is different when Portrait Mode is used.) Starting at the top of the screen on the left hand side you will see RNG. This is the range or distance to run to the destination point from your present position. This range figure is given in whichever units you selected on Screen 22, Map Customisation Screen. In the centre of the screen at the top you can read BRG. This is the magnetic heading to steer (assuming no wind) to the next turning point.

To the right of BRG at the top of the map is the ETE. This gives the Estimated Time Enroute (i.e. the estimated time, in hours and minutes, or minutes and seconds if under 1 hour, that it will take you to get to the destination point from your present position assuming you maintain your present ground speed.

On the Colour Skymap unit only, at the bottom of the map on the left is the ETA. This is the Estimated Time of Arrival at the next turning point. **Ensure you have set the local time offset correctly to get correct ETAs.** See Screen 5, Local Offset Screen. (The reason that ETA is not available on Colour Tracker is that, depending on the type of GPS receiver in use, real time is not always known.)

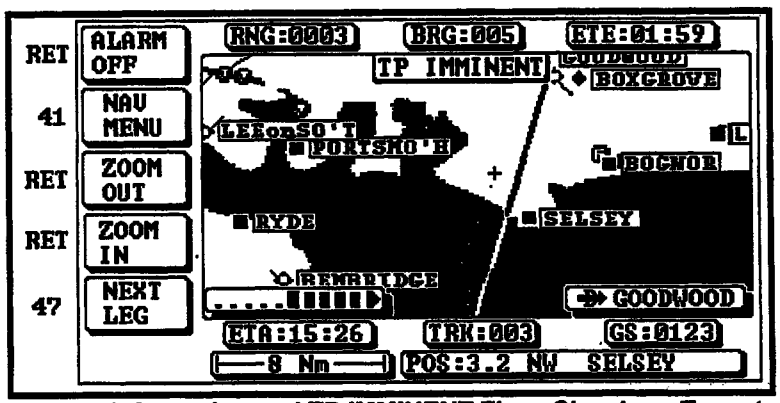
In the centre of the screen at the bottom is TRK. This is the actual magnetic track the aircraft is travelling over the ground. By comparing this with your magnetic heading you can make an estimate of the crosswind component.

To the right of TRK is GS. This is the actual ground speed of the aircraft and is displayed in Knots if you set the map units nautical miles on Screen 22, Map Customisation Screen, MPH if you set them to statute miles or KPH if the map units are set to kilometres. By comparing the GS with your TAS you can make an estimate of the head or tail wind component. Alternatively refer to Screen 58, Density Altitude, True Air Speed, and Winds Aloft Screen.

If ground speed is less than 0.5 Kts, the ETA, ETE, TRK and GS fields will be blank. The map will also revert to North Up at these low ground speeds even if Track Up is selected.

If you have entered this Screen 47 by activating a route, a GOTO can be performed on top of the route. You can initiate the GOTO either to an item from the database or by using the joystick pointer or by calling up one of the 10 nearest airfields or beacons. In each case Key 5's label will change to "GOTO OFF". The route that previously was active will fall into the background and will be replaced by the GOTO information. When the GOTO destination is reached or whenever you press the GOTO OFF Key (Key 5), the route and its information will be reinstated.

Arrival at an Enroute Waypoint



Screen 48: Nav Information and TP IMMINENT Flags Showing - Enroute Screen

To set the radius for the Arrival Alarm you should refer to the data on Screen 23, Nav Mode Customisation Screen. When the distance remaining to run to an enroute waypoint falls below the Arrival Alarm value, the [TP IMMINENT] flag is displayed and the internal and external alarms (if switched on) beep at a rate of 2Hz for 5 seconds. To make the change to NEXT LEG you have to press Key 1 and if you wish to quieten the alarm before the 5 seconds are up, simply press Key 5, the label of which has meantime changed to ALARM OFF. When the alarm is switched off automatically after 5 seconds, Key 5 will go blank and have no function for 2 seconds then revert to GOTO. This is a safety measure to prevent you from inadvertently selecting GOTO mode by pressing the Key just as it is cancelling automatically.

Once you have pressed Key 1 to select the next leg, Screen 47 re-appears showing all the relevant information for new leg.

If you pass the TP the flag will change to [TP PASSED]. If the unit has been set up for AUTO NEXT LEG in Screen 23, then as the TP is passed the unit will automatically revert to Screen 47 with all the new leg information. Key 1 will go blank and inactive for two seconds then revert to MAIN MENU.

When the TP Imminent alarm has been given, a new box will appear at the bottom of the screen showing the new course [NEW CRS XXX] to steer for the next leg of the route. The next leg of the route will also be displayed as a dotted line.

Prior to reaching a waypoint within a route, Turn Anticipation provides navigation along a curved path segment to ensure a smooth transition between two adjacent legs in the flight path. The curved path segment is based upon the aircraft's ground speed and the amount of course angle change between the legs.

Turn anticipation will only work if it is selected ON in Screen 23, Nav Setup, and if the course change is greater than 5° and less than 90°. If the course change is less than 5° then turn anticipation is not necessary. If the course change is greater than 90° it is up to the pilot which way round the turning point he turns.

If Turn Anticipation is set to ON and the upcoming leg satisfies the Turn Anticipation rules (i.e. course change>5° or <90°), the Turn Anticipation function is activated. If Turn Anticipation is switched OFF or the upcoming leg course change is>90°, you may get a STEEP TURN warning. The STEEP TURN warning will be given if the upcoming turn will involve a bank angle in excess of 25° based on current speed.

Arrival at Your Final Destination

Screen 49: Nav Information and TP IMMINENT Flags Showing - Final Screen

This Screen appears whenever the next waypoint is the last in the current route. When the distance to run to the last TP falls below the Arrival Alarm value, the [TP IMMINENT] flag is shown and the internal and external alarms (if switched on) beep at a rate of 2Hz for 5 seconds.

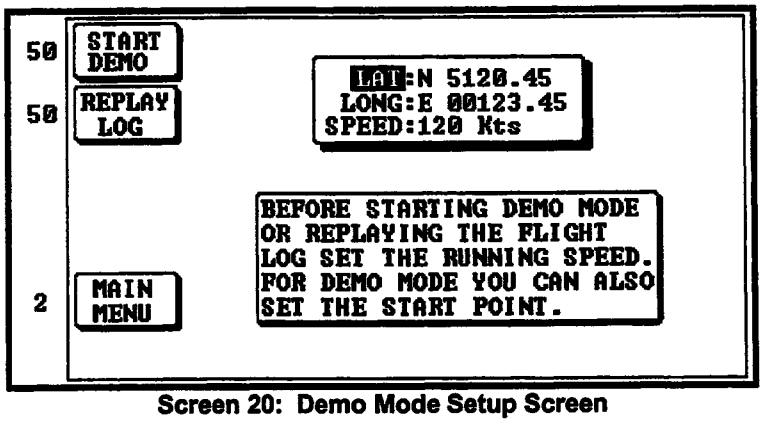
The label for Key 1 changes to NAV OFF and that for Key 5 changes to ALARM OFF. If you press Key 5 the audible alarm is silenced. The alarm will switch itself off automatically after 5 seconds, then after a further 2 seconds the label for Key 5 will revert to GOTO (or GOTO OFF if in GOTO mode).

If you are in Route Mode when Key 1 is pressed, NAV Mode is cancelled and Screen 38 is called. If you are in GOTO mode when Key 5 is pressed, GOTO Mode is cancelled and Screen 38 will appear. If you are in GOTO Mode with an underlying route still active when you press Key 5, GOTO Mode will be cancelled and Screen 47 will reappear with the original route reinstated.

As the last TP is passed, the flag will change to [TP PASSED].

DEMO MODE

To allow you to practice all aspects of navigation on the ground and to become familiar with handling it, your unit can be used as a simulator by selecting its fully functioning Demo Mode. Using this mode you can also replay your logged flight data.



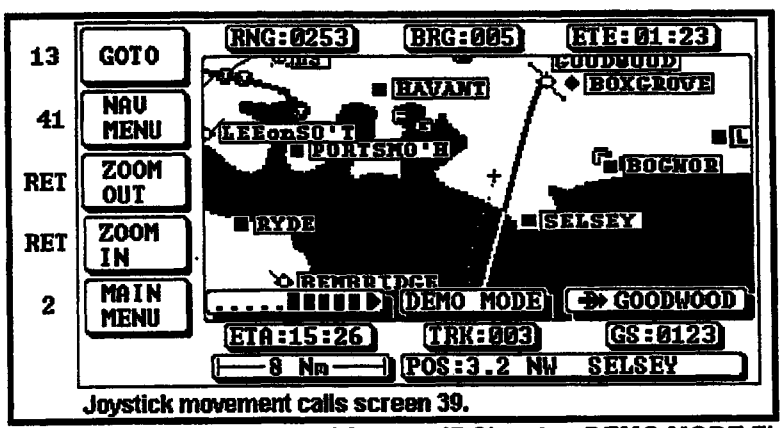
Screen 20: Demo Mode Setup Screen

This Demo Mode Screen can be accessed by pressing Key 3, DEMO MODE, on Screen 1, Title Screen, provided that, since the time you switched it on, your Colour Skymap has not received valid satellite information from its internal GPS receiver or your Colour Tracker similarly lacks fix data from its external receiver.

When you enter Demo Mode you will find a cursor over the word LAT. You can then use the joystick to set up the latitude and longitude for any point from which you want the demo to start. (The default lat and long will be the co-ordinates of your last fix position.) You can also set the airspeed at which you want to fly the demo to anything between 000 and 999 Knots.

Once you have set your position and speed, if you press Key 5 you will find Screen 38, Map Mode, displayed and you are ready to start Demo Mode. All map Screens that you access whilst Demo Mode is switched on will, for safety reasons, have a DEMO MODE warning box displayed to ensure you do not use them while in the air.

If you wish to replay the flight data logged into your unit, set the airspeed as explained above then press Key 4. Screen 38 will then be displayed with the logged data being replayed at the specified speed. This allows long routes to be replayed in fast motion.

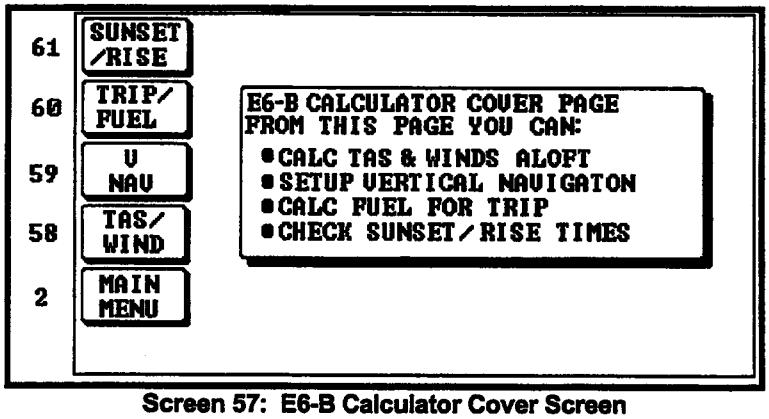


Screen 50: Representation of Screen 47 Showing DEMO MODE Flag

If Demo Mode is active and you switch to Screen 2, Main Menu Screen, you will see Key 3 is now labelled DEMO OFF and can be used to cancel Demo Mode.

E6-B CALCULATOR

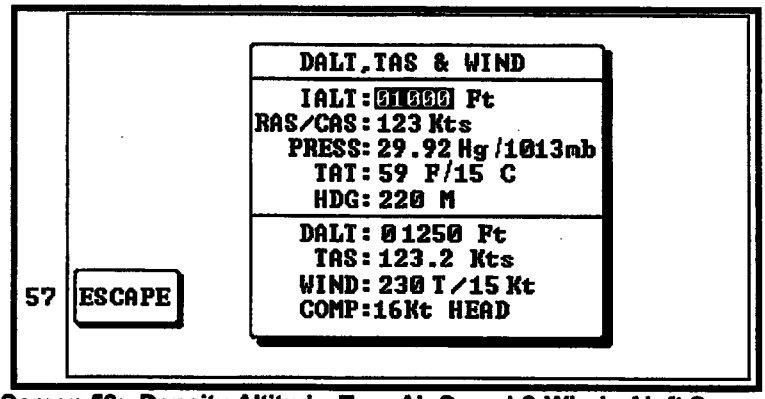
E6-B functions are accessible by pressing Key 3 in Main Menu when labelled E6-B CALC and takes you to Screen 57, E6-B Calculator Screen. This function is not available in Demo Mode. In this instance Key 3 in Main Menu is labelled DEMO OFF.



Screen 57: E6-B Calculator Cover Screen

Key 1 returns you to Screen 2 Main Menu.
Key 2 calls Screen 58, the Density Altitude/TAS/Winds Aloft Calculator page.
Key 3 calls Screen 59, Vertical Navigation page.
Key 4 calls Screen 60, Trip/Fuel Planning page.
Key 5 calls Screen 61, Sunset/Sunrise Calculator page.

Density Altitude/TAS/Winds Aloft Calculator



Screen 58: Density Altitude, True Air Speed & Winds Aloft Screen

On entry to this Screen a cursor will be positioned over the Indicated Altitude (IALT) input field.

To calculate Density Altitude (DALT) and True Airspeed (TAS) follow these steps.

1. Enter the altitude reading from your altimeter next to the IALT heading. Default value on entry to Screen is GPS altitude for Colour Skymap or 2000 for Colour Tracker.

2. Move the cursor over the entry field next to the heading RAS/CAS and enter your rectified or calibrated airspeed. Default value on entry to this Screen is GPS ground speed.

3. Move the cursor over the entry field next to the heading PRESS and enter the atmospheric pressure in either inches of mercury (Hg) or millibars (mb). Default value is 29.92Hg / 1013mb.

4. Move the cursor over the entry field next to the heading TAT and enter the total air temperature read from your **external** aircraft thermometer in either F or C. Default value on entry to this Screen is 59F/15C.

The calculated density altitude (DALT) and true airspeed (TAS) will now be correctly displayed in the lower half of the Screen.

To calculate winds aloft (WIND) and headwind / tailwind component (COMP), follow these steps.

1. Ensure you have followed steps one to four above so that TAS has been correctly calculated.

2. Move the cursor over the entry field next to the word HDG and enter the magnetic heading of the aircraft from your compass or DI. Default value on entry to this Screen is GPS Track

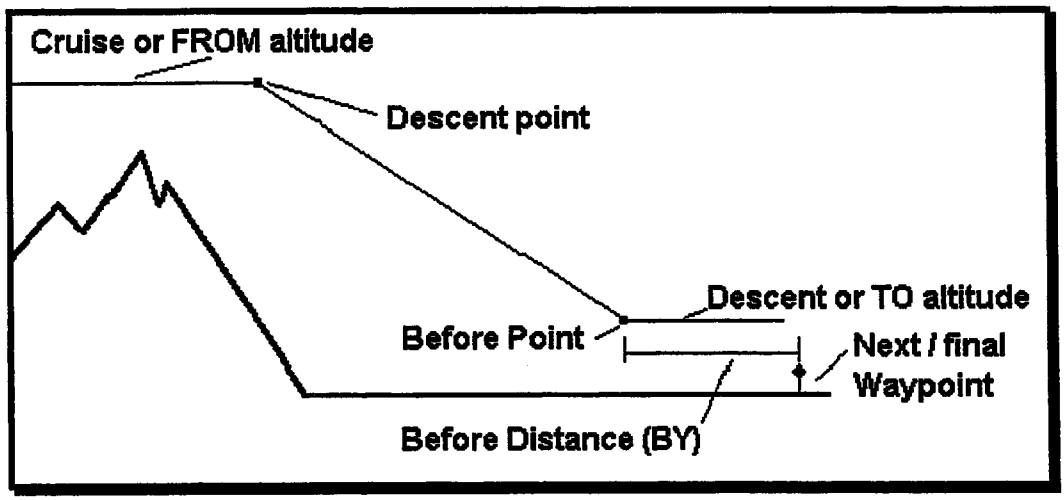
The wind direction and speed (WIND) along with the head or tailwind component (COMP) will now be displayed in the lower half of the Screen.

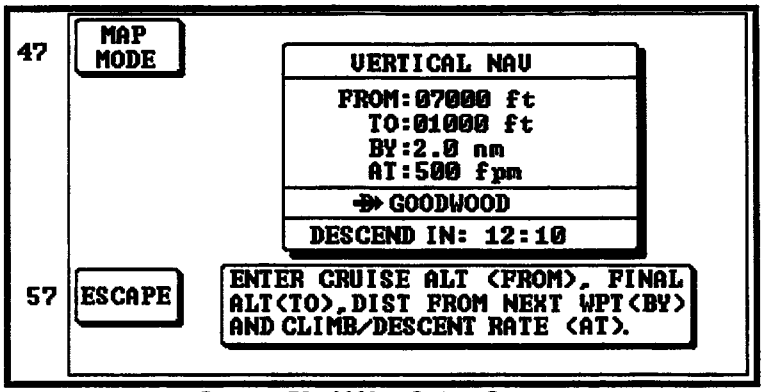
When the wind has been calculated and you return to the map Screen by pressing Key 5, MAP MODE, a wind arrow will be displayed on Screen, correctly orientated and pointing at the aircraft icon to give a visual representation of the wind direction with respect to the aircraft. The wind arrow will disappear after 30 seconds.

Vertical Navigation (VNAV)

VNAV is a function that tells the pilot when to start descending or climbing in order to reach a certain altitude at a certain distance from the next waypoint and is entered by pressing Key 3, VNAV, on Screen 57, E6-B Calculator Cover Screen.

This function can only be switched on when a Route is being flown or a GOTO is being executed, in other words, when there is a valid destination waypoint.





Screen 59: V Nav Setup Screen

On entry to Screen 59, if there is no active waypoint the DESTINATION box will read NO WPT. You must have an active waypoint in order to activate VNAV Mode. If there is an active waypoint the destination waypoint name will be shown.

Once in the VNAV Screen you must enter the cruise altitude (the altitude FROM which you will descend), the final altitude (the altitude you want to descend TO), the rate of descent (in FPM feet per minute) and the distance before the upcoming waypoint that you want to achieve the new level BY.

On entry to this Screen, the FROM value will default to GPS altitude if your unit is a Colour Skymap or to 5000 feet if your unit is a Colour Tracker (or the last set value). The TO value will default to 1500 feet (or the last set value). The BY value will default to 5.0nm (or last set value) and the AT value will default to 500fpm (or last set value).

The DESCEND IN box will show an active countdown of the time left before you should start your descent and will be recalculated if you change any of the four variables (FROM, TO, BY or AT).

If Screen 59 is entered then exited by pressing Key 1, VNAV mode is not activated, the values are simply retained for use later in the flight.

If Screen 59 is entered then exited by pressing Key 5, Screen 47, 47A or 47B (Nav Mode) Screen will be displayed with the following changes.

1. Key 5 will now read VNAV OFF and there is a new VNAV message box.

2. If the DESCEND IN counter is greater than 00:00, the new message box will show DESCEND IN with the counter value.

3. When the DESCEND IN counter reaches 00:00, the alarm will sound and a message will be displayed across the Screen saying START DESCENT NOW. Key 5 will change to ALARM OFF then back to VNAV OFF. Once Key 5 is hit or the alarm times out, the START DESCENT message will disappear and the VNAV message box will now show ADVISORY ALT: XXXXX ft and count down. The descent angle will be fixed at this point to prevent changes in ground speed from altering the descent profile.

When the advisory altitude is within 500 feet of the TO altitude, the alarm will sound again and a message will be displayed across the Screen saying FINAL ALT IMMINENT. Key 5 will change to ALARM OFF then back to VNAV OFF. Once Key 5 is hit or the alarm times out, the advisory altitude will continue to count down until it reaches the TO altitude. VNAV mode will then cancel automatically.

Should you wish to perform a GOTO or select a new route the VNAV Mode will need to be cancelled.

VNAV can be used for climbing as well as descending. If the FROM altitude is set to a lower value than the TO altitude then everywhere the words DESCENT and DESCEND appear, the word CLIMB will be used instead.

Trip/Fuel Planning

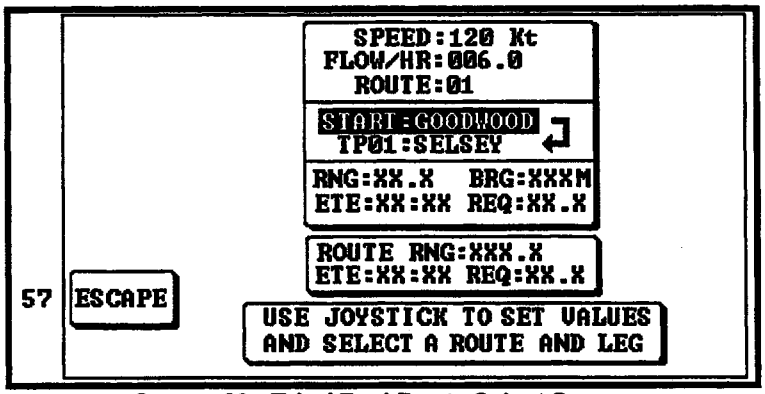
This feature is entered by pressing Key 4, TRIP/FUEL, on Screen 57, E6-B Calculator Cover Screen, and allows you to call up any route and view the following details about each leg of the route.

1. BRG (Initial Track, Magnetic)
2. RNG (Leg Distance)
3. ETE (Leg Time)
4. REQ (Fuel Required for Leg)

And for the total route:

1. RNG (Total Distance)
2. ETE (Total Route Time)
3. REQ (Total Fuel Required)

All you need to input is your cruising speed and your fuel burn. Fuel burn is entered in units / hour. The units are not important. If you fill your aircraft tanks using US gallons, enter your fuel flow in US gallons / hour.



Screen 60: Trip / Fuel Route Select Screen

On entry to Screen 60, the cursor will be positioned over the route number. Default speed will be 120 knots or that last set. Default flow/hour will be 6.0 or that last set. Moving the joystick up and down alters the route number. Moving the joystick right moves the cursor down to the leg selection. Moving the joystick left moves the cursor up to the flow and speed settings.

When using this function for the first time, move the cursor up to SPEED and set the cruise speed of your aircraft. Move the cursor down to FLOW/HR and set the fuel flow per hour for your aircraft. These settings will be permanently stored for later use.

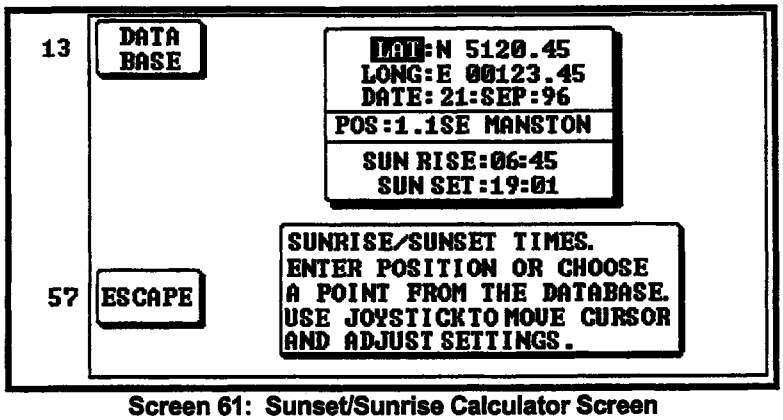
Next move the cursor down and select the route you want to perform the calculations for then move the cursor down again and scroll through the legs of your chosen route.

As you scroll through the route, the seven calculated fields in the lower part of the Screen will be updated. The four values grouped together (RNG, BRG, ETE and REQ) are the RNG (Leg Distance), BRG (Initial Track, Magnetic), ETE (Leg Time) and REQ (Fuel required for Leg) for the leg displayed.

The three values grouped below (ROUTE RNG, ETE and REQ) are the RNG (Total route distance), ETE (Total route time) and REQ (Total fuel required, no reserve) for the route displayed.

Sunset/Sunrise Calculator.

This feature is entered by pressing Key 5, SUNSET/RISE, on Screen 57, E6-B Calculator Cover Screen, and allows you to calculate sunrise and sunset times for any point in the world. You will be asked to input a lat, long and date. The sunrise and sunset time for that date will then be displayed in GMT.



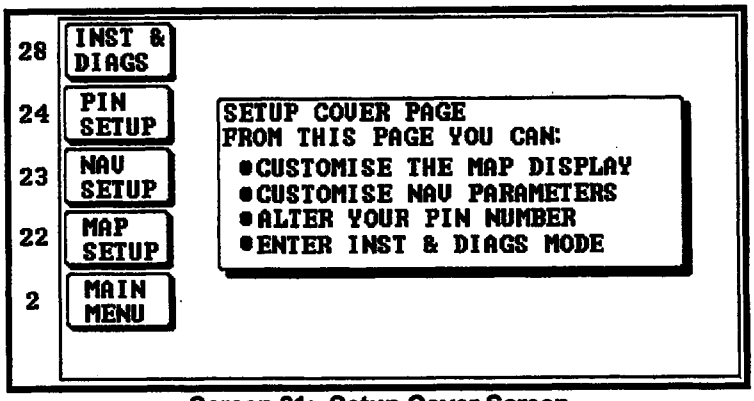
Screen 61: Sunset/Sunrise Calculator Screen

On entry to this Screen the present or last known latitude and longitude will show. The present date (Colour Skymap only) will also show. If your unit is a Colour Tracker, a default date value will be displayed.

You can now alter the lat, long and time with the joystick or alter the lat and long by choosing an item from the database. Key 5, DATABASE, calls Screen 13, Database Selection Screen, followed by 14 and 16. Once an item is selected, this Screen returns with the item's lat, long and name showing.

The POS, SUNRISE and SUNSET fields are all re calculated each time you alter the position or date.

SETUP SCREENS

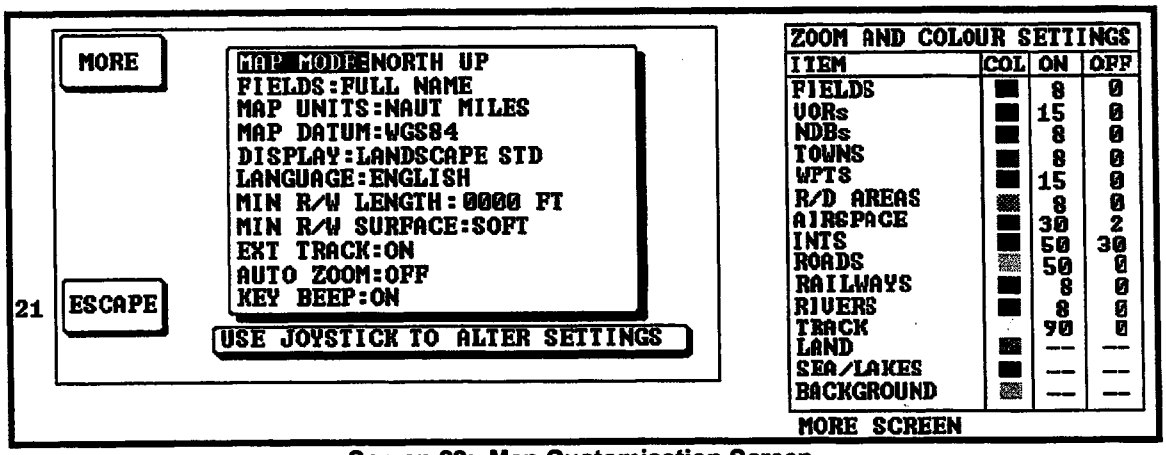


Screen 21: Setup Cover Screen

Your Skyforce unit allows you a great deal of flexibility to customise it to suit your own wishes and requirements. It also contains a high level of automatic self-testing and diagnostics. All customisation and diagnostic functions are grouped together in this setup section.

Key 1 returns you to the Main Menu
Key 2 gives access to Map Customisation Screens.
Key 3 gives access to Nav Mode Customisation Screen.
Key 4 gives access to Personal Identification Number (PIN) Setup Screens.
Key 5 gives access to Installation, Test and Diagnostic Screens.

Map Setup Screens



Screen 22: Map Customisation Screen

When this Screen first appears you will always see the current settings with a cursor over the words MAP MODE. You can then use the joystick to move the cursor up and down the list of headings. When the cursor is over the heading you wish to alter, move the joystick to the right. This will in turn move the cursor over to the set of options available for that heading. Moving the joystick up and down will then allow you to scroll through these options.

The various settings available for each heading are listed below:
(The default settings are those shown in the illustration above)

MAP MODE: NORTH UP/TRACK UP This allows you to choose whether to have the map displayed with north at the top of the Screen or orientated to have the aircraft's track aligned up the Screen.

FIELDS: FULL NAME/ICAO CODE This gives you the option of displaying the full names of the airfields (long ones truncated to 9 characters) or the ICAO 4-letter location indicators.

MAP UNITS: NAUTICAL MILES/STATUTE MILES/KILOMETRES This allows you to specify the units in which the scale bar and all navigation information will be displayed.

MAP DATUM: WGS 84/UTM/OSGB (World Geodetic System 1984 / Universal Transverse Mercator/Ordnance Survey Grid Reference). This option controls whether the unit operates with reference to Latitude/Longitude or UTM or OSGB grid references

DISPLAY: LANDSCAPE STD/LANDSCAPE INV/PORTRAIT STD/PORTRAIT INV Here you can choose the orientation of the display with respect to the Keys.

LANGUAGE: ENGLISH/FRENCH/GERMAN This is self-explanatory; it enables you to choose the language in which you would prefer the unit to operate.

MIN R/W LENGTH: This allows you to set the minimum length of main runway at the airfields which will be displayed when you ask the unit to display the ten nearest airfields. The minimum length can be specified in steps of 100 feet from 100 to 15,000 feet. By setting a minimum length you can force the unit to search for and display only airfields with runways which are equal to or longer than the preset minimum length.

MIN R/W SURFACE: SOFT/HARD Min R/W surface is also used when searching for displaying the ten nearest airfields in map mode. If set to soft, airfields with either hard or soft runways will be displayed. If set to hard, only airfields with hard runways will be displayed and soft-runway airfields ignored.

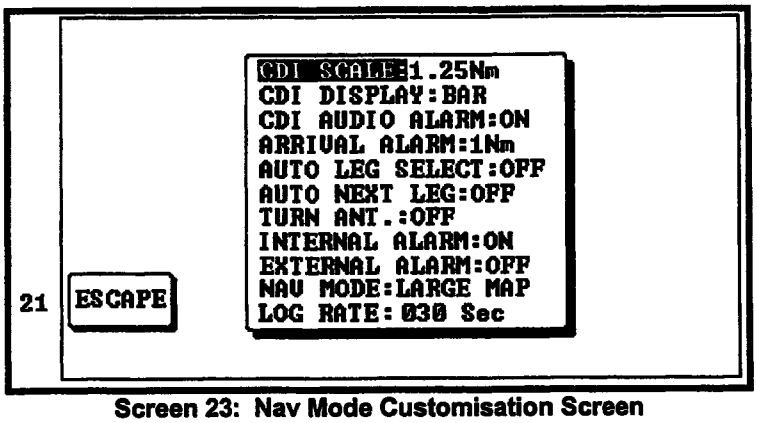
EXT TRACK: ON/OFF If you decide to turn EXT TRACK to ON, you will see in North Up Mode an extended track line drawn ahead of your present position in the direction of your present track. This can sometimes be useful to see just where the aircraft would end up if the present heading were maintained. Alternatively you can dispense with this map feature simply by selecting EXT TRACK to OFF.

AUTO ZOOM: ON/OFF AUTO ZOOM is a useful function to use as you approach your destination. When flying the LAST leg of a route or when flying a GOTO, as soon as the Range to the destination drops below ½ the scale bar range, the unit automatically zooms in so that the destination is always between ½ and one scale bars distance away. For example if you were using the unit when the zoom level was set with a 15nm scale bar, once the Range reading dropped below 8nm (½ x the scale bar) the unit would automatically zoom in to 8nm. When the RNG dropped below 4nm, the unit would zoom in to 4nm. etc.

KEY BEEP: ON/OFF. This allows you to select the beep that occurs when you press a Key or move the joystick on or off.

The Continuation Screen is accessed by pressing Key 5, MORE, and allows the map to be decluttered. It is impossible to include every item from the database within the graphic map display Screen, especially when zoomed out to the smaller scale maps. The Continuation Screen allows you to choose the level of zoom at which you wish each of these classes of data to become visible. To do this you have to select for each database item an ON and an OFF zoom level. The default levels are those shown in the illustration. If, for example you decide to set a particular class of item (say, VORs) to come ON at 8nm, the VOR icons themselves will be displayed without names at 15nm and both icons and names for VORs will be displayed at 8nm. If another class of item (say Towns) were set to switch OFF at 4nm, the town names will disappear from the Screen at the 4nm zoom level and their icons at the 3nm level. If you decide to set a class of item to switch off at 0nm then these items will stay ON right down to the fully zoomed-in level.

Nav Mode Setup



Screen 23: Nav Mode Customisation Screen

When you first enter this Screen the current settings are displayed with a cursor over the words CDI SCALE. You then have to use the joystick to move the cursor up or down. Once the cursor is over the heading you wish to alter, moving the joystick to the right will move the cursor over to the set of options available for that heading.

The various settings available for each heading are listed below:
(The default settings are those shown in the illustration above)

CDI SCALE: 0.5nm/1.25nm/2.5nm/5.0nm. This enables you to choose which of the given distances you want the unit to use as the setting for the full-scale deflection of the Course Deviation Indicator (CDI) in Nav mode.

CDI DISPLAY: BAR/NUMERIC/OFF This allows you to set the CDI display in Nav Mode to show either a bar-graph, or a numeric read-out of course deviation or to be switched off. If selected OFF, the CDI is no longer shown while you are in Map Mode.

CDI AUDIO ALARM: ON/OFF When selected ON this produces an audible alarm to tell you when full-scale deflection of the CDI has been reached. If you choose to set this to OFF, you disable this alarm.

ARRIVAL ALARM: Set between 1nm and 9nm You can use this feature to set the distance away from your destination waypoint at which you wish the audio and visual arrival alarm to be activated.

AUTO LEG SELECT: ON/OFF If you select this ON, the unit will automatically place the cursor on the closest leg when Screen 12, Route Program/Edit Screen, is accessed to select the route. Although the nearest leg to your present position is highlighted, an alternative leg may be selected. You do this by using the joystick on Screen 12 before you press Key 5. If AUTO LEG SELECT is switched OFF the cursor will simply be positioned over the first leg in the route whenever Screen 12 is selected.

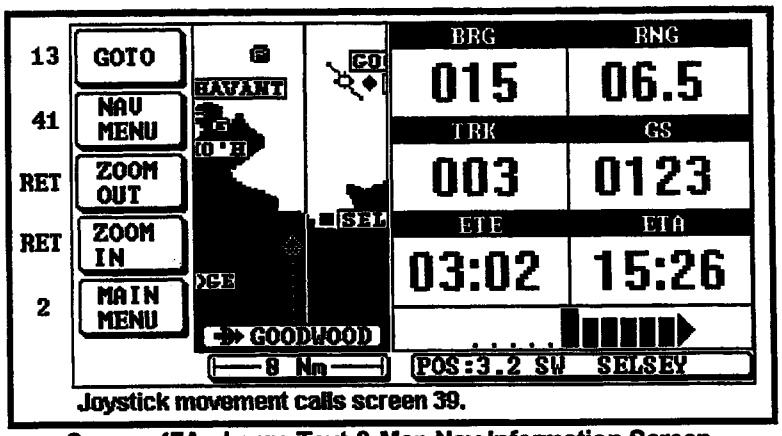
AUTO NEXT LEG: ON/OFF If you select this option ON then, as each waypoint in the route is passed, the next leg will be automatically selected. You thus do not need to press Key 1 (the NEXT LEG Key) as this function produces the same effect automatically. If you select AUTO NEXT LEG to OFF, you will then need to activate the next leg in the route manually by pressing Key 1 (the NEXT LEG Key) at the end of each leg, otherwise your unit will continue to give you range and bearing information to your previous turning point.

TURN ANT: ON/OFF If set to ON, the AUTO NEXT LEG will be set to ON automatically and the Turn Anticipation function will be activated to prevent steep turns at enroute waypoints.

INTERNAL (ARRIVAL and CDI) ALARM: ON/OFF This gives you the choice between having these internal alarms functioning or inactive.

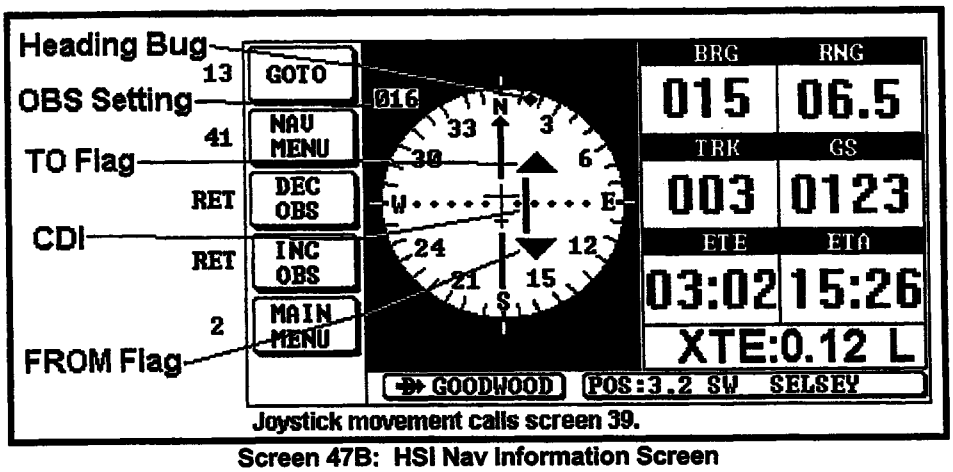
EXTERNAL (ARRIVAL and CDI) ALARM: ON/OFF This gives you the choice to switch ON or OFF the output from the unit which can drive an external alarm device.

NAV MODE: LARGE MAP/LARGE TEXT & MAP/HSI. This gives you the choice of three different Screen layouts in Nav Mode. LARGE MAP mode is described earlier in this Manual under the Map Mode with Nav Information (Screen 47) heading. The two alternative Screen layouts for Nav Mode are described below.



Screen 47A: Large Text & Map Nav Information Screen.

This Screen presents the numeric nav information in large text with a smaller map display to the left. As with standard Large Map Nav Mode, the CDI scale and format may be adjusted. If the joystick is touched, the display will immediately revert to Large Map format to allow full use of map graphics. When the joystick is reset, Screen 47A will be reinstated.



Screen 47B: HSI Nav Information Screen

This Screen presents numeric nav information in large text but instead of a map display, shows a conventional HSI to the left of the screen. The aircraft icon in the centre of the HSI will remain static and the outer ring will rotate with the aircraft's magnetic track. On entering Nav Mode or activating a new route leg or a GOTO, an OBS bug will be positioned on the HSI outer ring to indicate the desired magnetic track between the start waypoint and the destination waypoint (i.e magnetic bearing to waypoint if you were on track). There is also included a conventional TO / FROM flag.

Flying with the HSI is very similar to flying with a VOR indicator. Off track error (XTE) is represented by a bar (CDI) that moves left or right of centre. The centre of the scale represents the aircraft's position. As with a conventional HSI or VOR, to correct your track error, fly towards the bar. The full scale deflection or scale of the CDI can be selected on Screen 23, Nav Mode Customisation Screen.

In order to gain, and remain on the desired track, adjust your aircraft heading until the CDI bar is centred. Once the CDI is in the centre of the display indicating no cross track error (XTE), adjust your aircraft heading in small increments until the OBS bug located on the rotating track dial is at the top of the display. Once the CDI is centred and the OBS bug is aligned at the top of the display you are flying precisely along your desired track. If the OBS bug is aligned at the top of the display but the CDI bar is not centred, this indicates you are flying parallel to your desired track by however far the XTE is indicating.

The TO / FROM flag will normally point up to indicate you are flying TO the waypoint. When you pass your destination waypoint, the TO / FROM flag will point down to indicate you have passed the waypoint and you are now flying away FROM your destination. As you pass your waypoint and the FROM flag appears, the OBS bug will remain fixed at the set heading and the CDI will continue to show track error left or right of the extended track line.

If whilst enroute to a destination you decide that you would like to approach that destination point from an angle other than that displayed on the HSI by the OBS bug, you can alter the OBS bug setting by pushing the INC OBS (increment bug) or DEC OBS (decrement bug) Keys.

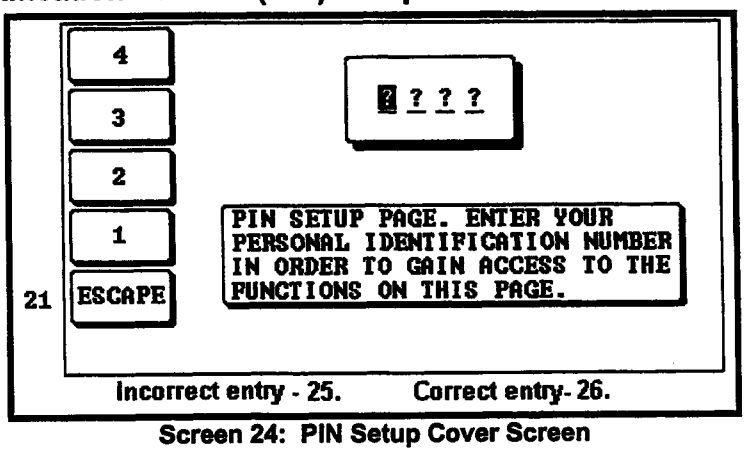
This has the effect of rotating your desired track line using the destination point as a pivot. For example if you were approaching an airport form the south west on an inbound heading of 070° but the runway in use at that airport was 09, it may be desirable to approach the airport on a heading of 090° so that you were lined up for the approach.

By pressing the INC OBS Key you would increment the bug setting from 070° to 090°. The CDI would then show a fly left indication because you would be off track to the right from your new track line. By turning left it would then be possible to intercept the new track line then fly straight into the airport on the new approach heading.

If the joystick is touched, the display will immediately revert to Large Map format to allow full use of map graphics. When the joystick is reset, Screen 47B will be reinstated. When flying with the HSI selected, TP IMMINENT messages and other warnings will be displayed in the HSI area.

LOG RATE: 000 - 999 seconds. This gives you the choice of how often your position is stored in memory for playback in demo mode or to a PC. A setting of 000 switches the logging function off. A total of 1000 fixes are stored in continuous wrap around memory (i.e. newest data overwrites oldest). To calculate total logging time, divide 1000 by the logging rate per minute (30 sec logging rate = 2 per minute). This will give the total logging time in seconds (i.e. 1000 points divided by 2 = 500 minutes = 8 hours 20 mins).

Personal Identification Number (PIN) Setup

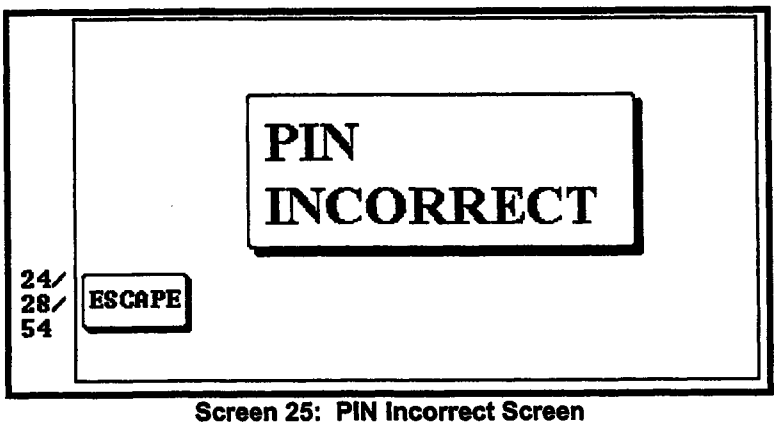


Screen 24: PIN Setup Cover Screen

We have provided the security feature of a Personal Identification Number (PIN) in your Skyforce unit with the main aim of preventing unauthorised persons from using your navigation equipment. You

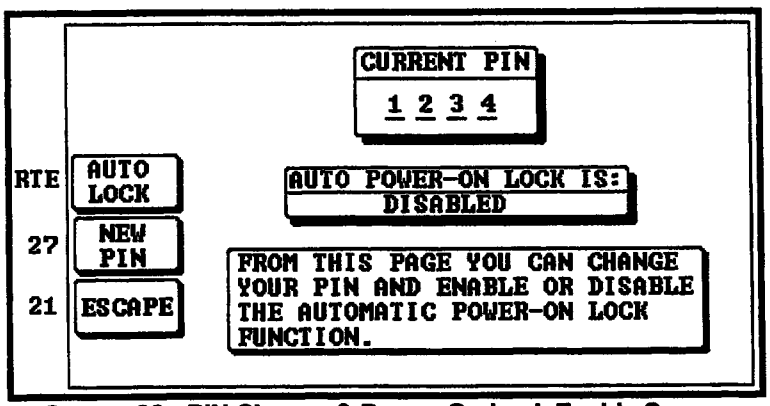
may use this Screen to set up your own choice of a four-digit personal number. This can be any permutation of the figures 1, 2, 3, and 4, e.g. 4412, 2433, 3124 etc.

On initial entry to this PIN Screen, by selecting Key 4, PIN SETUP, on Screen 21, Setup Cover Screen, you will find the cursor positioned over the first of four question marks. The joystick is not active and the current four-digit PIN must be entered by pressing Keys 2, 3, 4, and 5 (now labelled 1, 2, 3 and 4 as in the illustration above). The default PIN number which will be set when you receive the unit is 1234. As you enter each number by pressing each of the relevant Keys once, in the order that matches the PIN, each question mark in turn is replaced by an asterisk and the cursor moves one step to the right. When the last digit is entered, if you have failed to enter the correct four digits, Screen 25 (see illustration below) will be displayed.



Screen 25: PIN Incorrect Screen

If you get this PIN INCORRECT message, just press Key 1 ESCAPE and you go back to Screen 21 where you can make another attempt to enter the correct PIN. Unlike many bank Automatic Teller Machines, there is no limit to the number of attempts you can make to input the correct PIN to your Skyforce unit. Should you have the misfortune to forget your number, keep trying; there are only 256 permutations!



Screen 26: PIN Change & Power-On Lock Enable Screen

If you have managed to get the PIN correct then you move straight to Screen 26 as illustrated above. On entry to this Screen, the current PIN is displayed and the status of the AUTO POWER-ON LOCK is displayed. The default selection for this is DISABLED. If you wish to activate this power-on lock, pressing Key 3, AUTO LOCK, will change the setting to ENABLED.

Pressing Key 1 returns you to Screen 21, the Main Setup page.
Pressing Key 2 takes you into Screen 27 (see below) where you are able to change the PIN.

AUTOPILOT COUPLING

Normal Operating Procedures

Normal operating procedures for the GPS as a stand alone advisory navigation system are outlined in earlier chapters of this Manual. This section of the Manual deals specifically with the operation or the use of the Colour Skymap to drive an Autopilot. The system has been certified as suitable to drive the King KFC 150 Flight Control System, KAP 150 and KAP 100 Autopilot systems.

In order for the Colour Skymap to operate correctly in conjunction with an autopilot, the following external switches, indicators and annunciators must be provided.

CDI/HSI. The Colour Skymap must be wired to drive a CDI or HSI indicator showing cross-track deviation which should be located in front of the pilot. In addition to the cross-track indicator, the Nav Flag and the To/From Flags must also be wired.

Nav Flag. When the NAV FLAG is out of view on the HSI/CDI then the system is receiving valid NAV data from the Colour Skymap, in the event that the NAV FLAG drops then the GPS NAV data is invalid and a MESSAGE annunciation may also occur. If you switch NAV MODE off on the Colour Skymap, the NAV FLAG will drop but you will not receive a MESSAGE, because the system is operating normally.

Message Annunciator. The Colour Skymap must be wired to an amber coloured annunciator lamp labelled **MSG** located in the pilot's primary area of view. The annunciator will light every time a warning or advisory message is being displayed on the Colour Skymap's screen. Basically, the purpose of this annunciator is to say 'look at the Colour Skymap's display'.

Arrival or Waypoint Annunciator. The Colour Skymap must be wired to an amber coloured annunciator lamp labelled **WPT** or **WP ALRT** located in the pilot's primary area of view. The annunciator will light every time a waypoint or turning point is imminent.

NAV 1/GPS Switch. - By depressing this switch the Colour Skymap and NAV1 data will be alternatively displayed on the pilots HSI/CDI and selected for the autopilot/Fight Director. The source of the data being displayed will be annunciated on this switch with either Green for the NAV 1 system or Blue for the GPS system

> **NOTE :** Transmission on VHF communication frequencies 121.150, 121.175, 121.200, 131.250, 131.275 and 131.300 MHz may adversely affect reception of the GPS signal. Transmissions in excess of approximately 5 seconds may result in loss of GPS signal reception. Navigation will be restored within 5 seconds after the completion of the transmission.

Flight Director or Autopilot Coupled Operation

Commencing a route or a GOTO

Initiate a route or a GOTO on the Colour Skymap in the normal way, as described in earlier chapters of this Manual. Once the Colour Skymap has entered NAV or GOTO MODE, ensure you are on track then read the initial bearing to waypoint from the Colour Skymap screen [BRG:XXX] and select this course on your panel mounted HSI/CDI using the OBS knob. Next press the NAV1/GPS switch so that the blue GPS indicator is illuminated (this will route the GPS information to your panel mounted instruments) and then engage your autopilot.

Waypoint Transitioning

To ensure correct autopilot operation, TURN ANTICIPATION and AUTO NEXT LEG must both be selected ON in the Colour Skymap Nav Setup Screen (this is the default setup ex-factory on software version 2.10 and above).

The point at which you are alerted to an approaching waypoint depends very much upon the change in heading required to transition onto the next leg.

1. *Less than 5^0 Heading Change:-* If the change in heading between the inbound and outbound leg is less than 5 degrees, then the ARRIVAL/WAYPOINT Annunciator will illuminate when the arrival alarm point is reached and will remain illuminated until the next leg is established. The arrival alarm point can be adjusted in the NAV SETUP page on the Colour Skymap GPS, the default is 1nm.

2. *5^0 to 90^0 Heading Change:-* If the change in heading from the inbound leg to the outbound leg is between 5 degrees and 90 degrees, the panel mounted ARRIVAL/WAYPOINT Annunciator will illuminate at the point where you should commence a rate one (two minute) turn on to the new heading. The curved path to follow in order to establish the new leg at rate one will be displayed as a dotted line on the map display. The ARRIVAL/WAYPOINT Annunciator will remain illuminated until the turning point is passed and the new leg established.

3. *Greater than 90^0 :-* If the change in heading is greater than 90 degrees between the inbound and outbound legs the Colour Skymap will illuminate the ARRIVAL/WAYPOINT Annunciator, when the arrival alarm point is reached as in 1. above.

In all cases the panel mounted MESSAGE Annunciator will illuminate at the same time as the ARRIVAL/WAYPOINT annunciator. The MESSAGE annunciator will then switch off after five seconds. The message box on the Colour Skymap will display the following **[NEW CRS:XXX]** and the new leg will be displayed as a dotted line on the map display. At this point you must select the new course on your panel mounted HSI/CDI by rotating the OBS knob. The autopilot should then steer the aircraft smoothly onto the new leg.

Once the waypoint has been passed and the new leg established, all the information boxes on the Colour Skymap screen will be automatically updated with the new leg and destination information. The old leg will then be removed and the dotted new leg will become a solid line on the moving map display.

In the 5^0 to 90^0 Heading Change case, the Colour Skymap calculates the actual curved path of the turn (turn anticipation feature) so when you receive the message to start the turn and have selected the new course, the autopilot will keep the CDI centred and you will follow a rate one turn precisely onto the new track.

Abnormal Emergency Procedures

The Colour Skymap, when coupled to the aircraft navigation system provides clear warnings of events that require pilot attention/action, the messages provided are:-

Standard Warnings

1. MESSAGE Annunciator :- If this Annunciator is illuminated it means one of the following conditions is occurring; either no output from the GPS, no navigation fix in the GPS, CDI alarm, Steep Turn warning, Turning Point Imminent (5 seconds only), Turning Point Past, Marker Zone infringed., i.e. if the MESSAGE Annunciator is illuminated then there will be a message on the GPS display that requires attention/action.

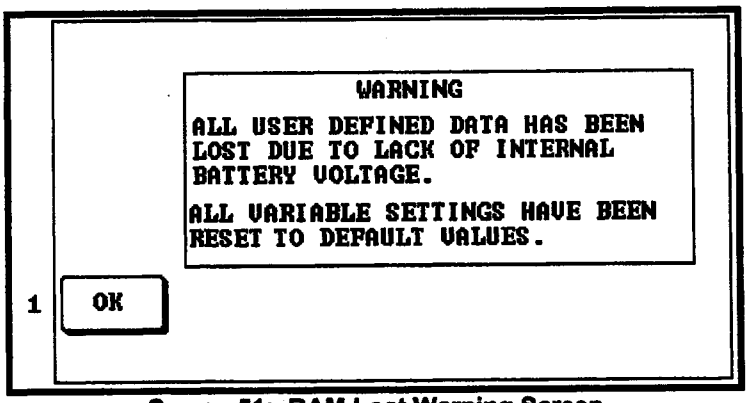
2. *NO FIX POSSIBLE* (On Colour Skymap Display):- Displayed on the unit indicates that the Colour Skymap has not acquired valid signals that allow for a 2D/3D fix for navigation to be achieved, this warning will be repeated via the MESSAGE Annunciator.

3. *NAV FLAG* (HSI/CDI Flag):- If this flag is visible on the HSI or CDI with the GPS system selected for navigation with a current FIX, it indicates that there is no valid output data from the Colour Skymap to the HSI, or that the GPS is not in NAV or GOTO MODE. Reversion to NAV 1 will normally occur automatically, assuming that the system is installed as shown in the Installation Manual i.e. with NAV 1 as the primary navigation source.

Loss Of Power

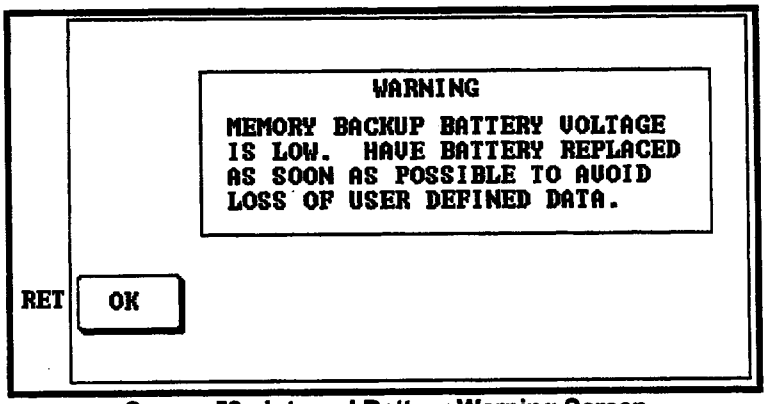
In the event off loss of power to the Colour Skymap, the system will power down and the HSI will automatically revert to the NAV 1 data source when wired in accordance with the Installation Manual. With navigation information not available or invalid, utilise remaining operational navigation equipment as required.

APPENDIX 01: Warning Screens


WARNING
ALL USER DEFINED DATA HAS BEEN LOST DUE TO LACK OF INTERNAL BATTERY VOLTAGE.
ALL VARIABLE SETTINGS HAVE BEEN RESET TO DEFAULT VALUES.
1
OK

Screen 51: RAM Lost Warning Screen

This Screen is automatically displayed immediately after you switch the unit ON if the RAM initialisation check detects corrupted data. Pressing Key 1 causes a total RAM clear to be carried out and default values to be set up. Once the RAM has been cleared, Screen 1 will appear and the initialisation checks will be continued. If the RAM Lost Warning Screen appears you should contact your Skyforce dealer for advice.

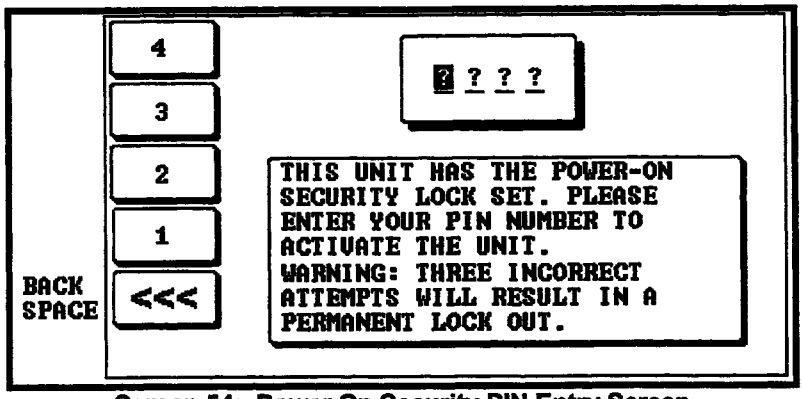

WARNING
MEMORY BACKUP BATTERY VOLTAGE IS LOW. HAVE BATTERY REPLACED AS SOON AS POSSIBLE TO AVOID LOSS OF USER DEFINED DATA.
RET
OK

Screen 52: Internal Battery Warning Screen

This Screen will appear if at any time during operation the lithium memory battery voltage is found to be low.

By pressing Key 1 you can return to whichever Screen was showing before the low voltage condition was detected.

When a low-voltage condition is detected and has been indicated by this Screen you should contact your Skyforce dealer as soon as possible to arrange for replacement of the lithium memory battery.

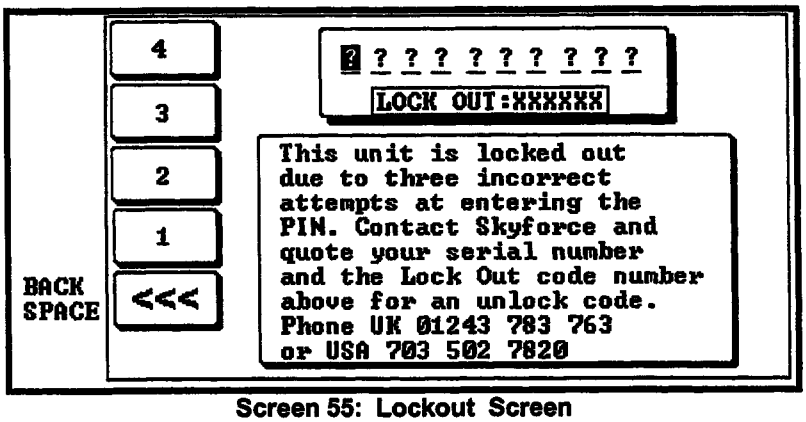

4
3
2
1
BACK SPACE
<<<
? ? ? ?
THIS UNIT HAS THE POWER-ON SECURITY LOCK SET. PLEASE ENTER YOUR PIN NUMBER TO ACTIVATE THE UNIT.
WARNING: THREE INCORRECT ATTEMPTS WILL RESULT IN A PERMANENT LOCK OUT.

Screen 54: Power On Security PIN Entry Screen

If the Auto Power-On Lock function has been activated on Screen 26, this Screen will be called during initialisation. You must then input the correct PIN before you are allowed to move back to Screen 1 with full access to all functions.

If an incorrect PIN is entered, Screen 25 will appear and Key 1 will revert to this Screen. If an incorrect PIN is entered on three consecutive attempts, **even if the unit has been switched off and back on again between attempts,** Screen 55 will appear. The number of incorrect attempts that have been made is stored in NVM and increased with each incorrect attempt or cleared down once you have managed to enter the correct PIN.

As the PIN is entered, asterisk characters are displayed in place of the question marks. Key 1 can be used as a Back-Space Key.


4
3
2
1
BACK SPACE
<<<
? ? ? ? ? ? ? ? ?
LOCK OUT:XXXXXX
This unit is locked out due to three incorrect attempts at entering the PIN. Contact Skyforce and quote your serial number and the Lock Out code number above for an unlock code.
Phone UK 01243 783 763
or USA 703 502 7820

Screen 55: Lockout Screen

This Screen will only appear after three incorrect PINs have been entered on Screen 54 (or if when you switch the unit on the NVM is found to have accumulated three unsuccessful PIN input attempts).

The LOCK OUT number is a random five digit number that the unit generates. This is held in RAM and does not change until an unlock number is entered. The unit can be switched off and on with this Screen showing but the LOCK OUT number will remain the same.

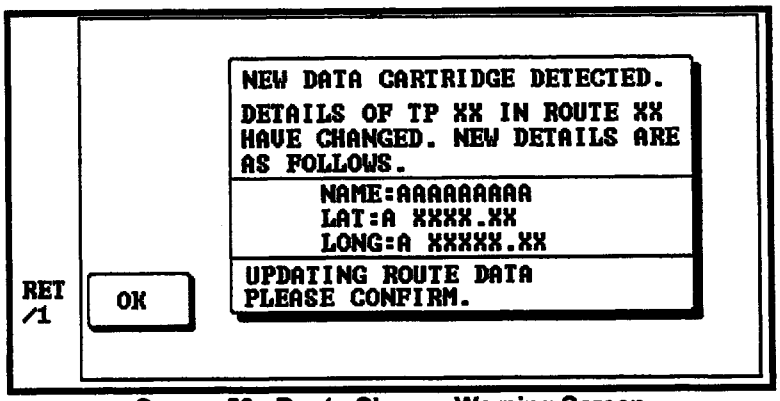
If you get locked out of the unit, in order to re-activate the unit, you will need to telephone the Skyforce contact number displayed and provide them with your Serial Number and the Lockout Number. Your details will be verified and checked against the Skyforce database and register of stolen units. Once the operator at Skyforce is satisfied that the unit has not been stolen and that you are the officially recognised owner, you will be given an Unlock Code Number.

This Unlock Code is a 10-digit number. You must enter this into your unit on Screen 55. The digits will replace the question marks as each one is entered. The Unlock Number is deemed to be entered as the last digit is input. Every time an incorrect unlock number is entered, the unit will generate a

new LOCK OUT number. This makes it impossible for a would be thief to stumble upon the unlock number by trial and error. The chances of guessing the correct unlock code are 10 million to 1.

Once a lock out has occurred and the unit has been re-activated with an unlock number, the PIN will be reset to the default of 1234.

Be very careful if you activate the Auto Power On Lock feature. Locking yourself out of the system can be very inconvenient.



Screen 56: Route Change Warning Screen

If, during initialisation, a new SkyData Module is detected by the software, the unit will check through the routes programmed into the unit and validate the data.

Whenever you build a route by using items from the SkyData Module, the Name, Lat and Long of each chosen item is copied into RAM along with a note of which database and which country you extracted it. When a new SkyData Module is detected, each item in each route is checked against the new database.

This is done by reading the first item from the first route in RAM and conducting a search through the relevant part of the new SkyData Module looking for a Name match. If a perfect match is found for the Name, the Lat and Long are then checked and if they match correctly also then no action is required and the software goes on to check the next item.

If a discrepancy is found in either, Lat or Long, Screen 56 will appear showing the new information for the Waypoint in question. You must confirm that you are aware of the change by pressing Key 1.
If no match can be found for the name (i.e. the name has been changed or the item has been deleted from the new database) the Lat and Long fields on Screen 56 will be left blank and the bottom section of the box will read:

CHANGING DATABASE REFERENCE
PLEASE CONFIRM

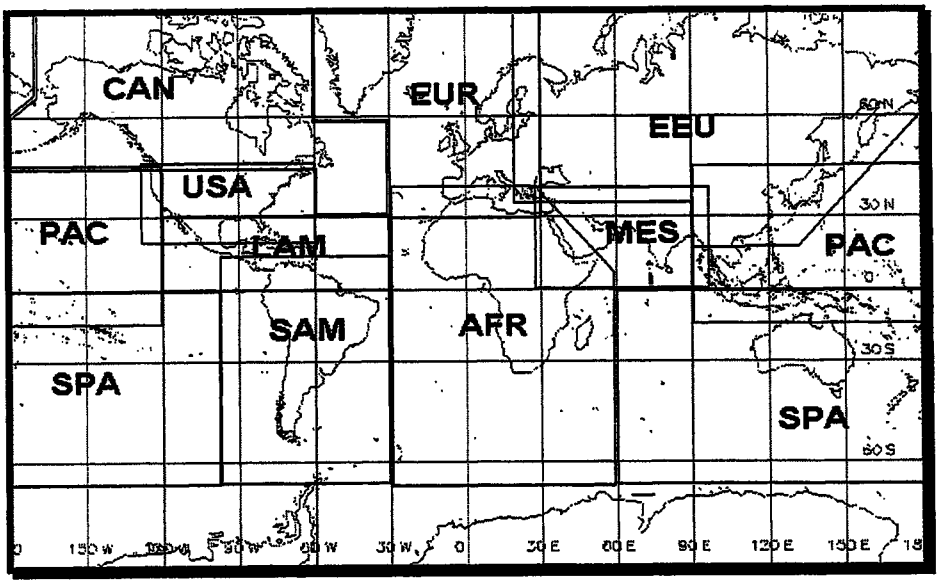
Pressing Key 1 will change the database reference displayed on Screen 12 to OW indicating that this item is now an Old Waypoint and is no longer accessible from any database.

This check is carried out for every point in every route and whenever discrepancies are found, Screen 56 will appear on each occasion.

APPENDIX 02: SkyData Modules

Skyforce produce a series of SkyData Modules based on the ICAO/ARINC geographic areas for Colour Skymap and Colour Tracker. The world can either be broken down into ten or three separate SkyData Modules. Each module for each area contains the appropriate Jeppesen aeronautical data and geographic data to a high resolution and the operating software.

The ten ICAO/ARINC areas along with their three letter identifiers are:



EUR	Europe	CAN	Canada	MES	Middle East
USA	USA	PAC	Pacific	EEU	Eastern Europe
SPA	South Pacific	LAM	Latin America	AFR	Africa
SAM	South America				

The three separate areas that between them cover the world are specified as follows:

Americas - AMR(comprising CAN, USA, LAM, SAM)
Atlantic International - ATI(comprising EUR, AFR, EEU, MES)
Pacific International - PAI(comprising PAC, SPA, EEU, MES)

Please contact your Skyforce Dealer for database availability.

To change the SkyData Module follow these simple steps:

1. Ensure that the unit is switched OFF.

2. Grasp the SkyData Module by the exposed edge and pull straight out of its socket.

3. Being careful to ensure that the indentation on the facing edge of the SkyData Module is lower most, press the new card firmly home into the socket.

4. Switch the unit on and check for correct position. Screen 56 (Refer to Appendix 01) may be displayed if changes to information featured in your routes are detected.

APPENDIX 03: How Does GPS Work?

What Is GPS?

Many of the radio-navigation aids used in aviation were originally developed for military use but have now been made freely available to civil users. The Global Positioning System (GPS) has a similar history. The GPS constellation of satellites is an American military facility operated by the US Department of Defense (DoD). This constellation consists of 21 operational satellites plus three spares held in reserve to replace any of the active ones which might fail. They orbit approximately 10,900 nm above the earth in six planes inclined at a 55 degree angle to the Equator and circle the earth twice daily. The orbits are so arranged that a minimum of four satellites will always be visible from any part of the earth's surface at any time. This allows suitable receivers to make extremely accurate determination of latitude, longitude, altitude, velocity and time from satellite signals received by an aircraft, airborne or on the ground.

How Does It Work?

Each satellite carries an extremely accurate atomic clock and continuously transmits precise timing waveforms and data concerning its health status and almanac, orbital information and clock timing corrections. The signals have been designed to be extremely resistant to interference from terrestrial radio transmissions, electronic equipment and weather.

The technique used to establish position using these satellites is one of simple ranging. In other words, position is calculated from measurements of the distances between the observer and a number of satellites. The exact position of each satellite at any given time is known. This information is actually transmitted by each satellite every few minutes. The precise time (in relation to Universal Time) that each satellite starts to transmit its coded signal is also known.

Given this information and the speed of radio waves through space, it is possible to establish the exact distance from each satellite by simple mathematics. For example, if a car leaves point A at exactly 1 o'clock and travels at sixty miles an hour to point B which it reaches at exactly 2 o'clock, we know the distance between points A and B must be sixty miles.

In order to achieve the required degree of accuracy from this technique it would normally be necessary to have an extremely accurate atomic clock built into each receiver as well as each satellite. This would not be viable as each receiver would then cost tens of thousands of pounds. Instead, an ingenious system is used whereby GPS receivers require to be fitted with only reasonably accurate (and thus low-cost) clocks. This involves two important techniques:

1) Code matching or synchronisation. Each satellite transmits, for civilian use, a unique 1023 bit code. This code is repeated every millisecond (one thousandth of a second).

In the receiver, circuitry generates an identical code that is then slid back and forth in time until it exactly matches the code being received from the satellite.

When a perfect match is achieved, the time at which the receiver is generating the start bit of the code is recorded. The difference in time (or offset) between the receiver generating the code and the satellite generating the code is therefore measurable because the time at which the satellite should have generated the code is known.

This gives a very accurate way of measuring the time differences between transmission and reception of the signals generated by the satellites, but does not help with the need for an absolute time reference. One must bear in mind that if the clock in the receiver were only 100 milliseconds (one tenth of a second) out with respect to universal time, the calculated distance from the satellite would have an error of 1,860 miles.

This problem is overcome by a second technique:

2) Making use of an extra satellite. In order to obtain a positional fix in three dimensional space, it is necessary to know the exact distance to each of three satellites. The exact distance is however not known because of the presence of an offset or error in the receiver's clock with respect to universal time.

A fix is nevertheless calculated using the three satellites, all be it erroneous. Once this fix is calculated, a second fix is calculated using satellites 2 and 3 in conjunction with a fourth satellite. This is repeated for satellites 3, 4 and 1 then 4, 1 and 2. This gives four calculated points in space.

If the four calculated points do not overlap, a timing error must be present.

A slight correction is then fed into the receiver's clock and the points are calculated again. They move closer to each other.

This process is repeated until all the calculations tie up correctly at the same point. The exact position in three-dimensional space is then known and the offset in the receiver's clock eliminated.

Similarly, a two-dimensional fix can be established from three satellites.

As a result of this technique the receiver does not initially need to know absolute universal time. All that is needed is a reasonably stable clock for taking relative measurements over the short periods between the signals received from each satellite.

An approximate knowledge of universal time is required, to know which satellite to expect in which part of the sky. This is usually given by the first satellite the receiver acquires after switch on.

The exact universal time is transmitted as part of the almanac and health status data by each satellite. This is then corrected by the receiver for signal transition delay as part of the position fix calculations.

Accuracy and Reliability

All GPS satellites transmit two separate pseudo-random codes on two different frequencies.

The most accurate is the P code which is transmitted at both 1.2276 GHz (1.2276 thousand million cycles per second) and 1.57542 GHz.

The P code is extremely complex and has a repetition rate of one week. This code is restricted to military use only, is capable of supreme accuracy and is supposedly unbreakable.

The signal available to civilian users is transmitted on 1.57542 GHz only and is called the C/A code. C/A stands for Coarse Acquisition.

This code is relatively simple compared to the P code and has a repetition rate of one millisecond.

The present maximum accuracy for receivers using the C/A code is 15 meters.

There is the possibility however of this being intentionally degraded (by feeding random errors into the satellite clocks) to 100 meters for strategic reasons. This is called Selective Availability or S/A and can be implemented at will by the DoD.

Day to day accuracy is monitored by Falcon Air Force Base, Colorado, who receive information from a group of ground stations positioned at Ascension Island, Diego Garcia, Kwagale and Hawaii.

These stations receive the satellite signals and check them for timing accuracy. If any errors are detected, error information is transmitted back to the satellite, which then corrects itself.

Reliability should be good when the full constellation of 24 satellites are in orbit.

Each satellite has three separate clocks on board (one in use and two standby) and in the event of the total failure of a satellite, one of the spares already in orbit can be manoeuvred into position within a few hours.

The only time the DoD can predict there may be a substantial break in coverage for civilian users, is at a time of National Emergency, when the whole system may be reverted to P code (military) operation only, for strategic reasons.

Having said this, the system remained fully available to civilian users during the Gulf conflict.

Further Information

Information on the day to day status of the GPS constellation is available from a number of sources. See Appendix 05 for full details.

APPENDIX 04: Differential Functions (Colour Skymap only)

Your Skyforce unit has been designed to enable it to be upgraded to make use of Differential GPS (DGPS). Please contact your Skyforce dealer for further details.

What Is DGPS?

GPS on its own is, as we have seen in Appendix 03, an extremely accurate system for all general navigation purposes. It is not, however, perfect. The most significant source of error in GPS positional calculations is the deliberate downgrading of accuracy known as Selective Availability (SA) described in Appendix 03. Satellite clocks, although superbly accurate, also have tiny errors which can affect the accuracy of a fix. So also does any slight drift from a satellite's predicted orbit. The signals from satellites have to pass through the earth's atmosphere and, although radio signals travel at the speed of light, this is only a constant through a vacuum. Things like water vapour in the troposphere and charged particles in the ionosphere do slow down satellite signals and cause slight delays that translate into errors in position. And finally it must be admitted that GPS receivers are not perfect either. These can themselves induce further small positional errors, mainly as a result of receiver noise or clock inaccuracy.

DGPS can virtually cancel out all of the errors due to SA, to orbital errors and to satellite clock inaccuracy. It also greatly reduces any error caused by the atmospheric delay to radio signals. What DGPS cannot correct for are only the inaccuracies due to the GPS receiver itself and possible "multi-path" errors which (like "ghosting" on a TV) are due to secondary signals being received after reflection off local obstructions. The net result of all this is that while standard GPS can experience errors of between 15 and 100 metres (depending largely on whether SA is active or not) DGPS is already capable of accuracies down to 1.3 metres horizontally and 2.0 metres vertically.

How Does DGPS Work?

Any two GPS receivers within a few hundred miles of each other will receive satellite signals which have been affected by virtually the same errors as each other. The signals emanate from the same group of satellites, travel through the same portion of the earth's atmosphere and so will be subjected to the same delays. Thus, all the errors (except those due to multi-pathing and to the receivers themselves) will be common to both. So if one of these receivers is located at a fixed point which has been extremely precisely surveyed it can be used as a reference. Instead of using the signals to calculate its position, since it already knows its position it can calculate the errors in the incoming signals.

Having established the magnitude of the errors all that is then needed is an associated transmitter broadcasting signals to tell any mobile GPS receivers in the area exactly what these errors are. The mobile GPSs are then able to use this data to correct for the errors in their raw calculations and to come up with the positional accuracies mentioned above. DGPS even removes the deliberate degrading of accuracy associated with the DoD's Selective Availability. It is essential to process the data from the reference receiver very rapidly and to transmit the correction data to the mobile GPS receivers almost instantaneously since, especially if SA is active, these errors are constantly varying. Transmitters and receivers have to be designed to work at high baud (bits per second) rates to transfer the necessary data before it becomes out of date.

Uses Of DGPS

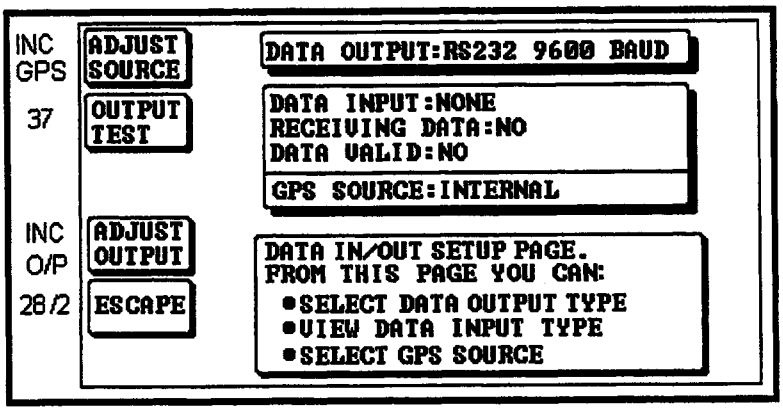
Standard GPS provides very adequate accuracy for most navigational tasks, but the additional precision available through DGPS opens up other possibilities in aviation and in many other spheres of activity. Once the aviation authorities are prepared to approve DGPS-based low-visibility approach and landing systems, these could provide low-cost precision facilities world-wide. The benefits of this could be especially useful at small airfields where the expense of an ILS or MLS system could never be justified and in developing countries where few if any navigation aids exist today.

DGPS has also already become an essential tool of the off-shore oil industry, enabling drill bits to be placed with more precision than any other system. Marine navigation, survey work and cartography, emergency services, agriculture and forestry and road transport fleet management are just some of the non-military applications already relying more and more upon the accuracy of DGPS.

Data Connection

In order to make an electrical connection to a differential receiver please refer to the accompanying Installation Manual.

Once connected to an operating differential receiver, switch your Colour Skymap on and select Screen 35 by pressing Key 4 (SETUP) then Key 5 (INST & DIAGS) then Key 5 (DATA IN/OUT). The words RTCM SVC-104 should be displayed next to the DATA INPUT heading. If the word NONE is still displayed next to the DATA INPUT heading your unit may require an upgrade in order to operate in differential mode. Contact your Skyforce dealer for details.



Once valid data is recognised and differential sentences are being decoded, the word YES will be displayed next to RECEIVING DATA. If the data is not recognised or is not present, the word NO will be displayed. If the data format is valid, the word YES will appear next to the words DATA VALID, if the data format is not valid then the word NO will be displayed.

If the unit indicates that it is receiving data and that the data is valid, the unit will switch into differential mode when it obtains a fix. In Map Mode a small D will appear at the bottom of the screen to indicate differential mode is active. Differential mode will also be indicated on the GPS Status Screen.

APPENDIX 05: GPS Information Sources

Information on current GPS satellite status is available daily from a number of sources.

By Modem Using A PC Or Home Computer

Bulletin Boards

The United States Coast Guard have a computer bulletin board service for anyone who has a computer and modem. The USA number to call is +1 703 313 5910. Modem speed can be anything between 300 and 14,400 baud with a data format of 8 data bits, 1 stop bit and no parity.

The Royal Institute of Navigation also run a UK-based computer bulletin board (RIN BBS) containing GPS information. The UK number to call is + 44 (0) 115 9422111.

Internet

GPS information is available from several sources on the internet. These include:

http://www.navcen.uscg.mil/gps/gps.htm
http://www.skyforce.co.uk

By Telephone

The United States Coast Guard run a GPS Information Centre (GPSIC) which offers a pre-recorded daily status message. The USA number to dial is + 1 703 313 5907.

APPENDIX 06: Service and Warranty

Due to the Company's policy of continual development and routine database updates, new SkyData Modules will become available every 28 days. As a registered owner of a Colour Tracker or Colour Skymap, you will be offered a 1/3/6/12 monthly SkyData Module subscription. **Keeping your database current is your own responsibility and is extremely important from a safety viewpoint.**

To validate your warranty you should fill in and return the enclosed Product Registration Module within 10 days of purchase. Failure to register your unit may result in loss of warranty.

Registering your unit is also essential if you wish to receive an unlock code over the telephone in the event of a PIN lockout. If your unit is not registered, your only option will be to return the unit to a Skyforce facility. Registering your unit also provides a means of contacting you with information on any new SkyData Module upgrade.

If you have a change of address or sell your unit on to someone else, or if your unit is lost or stolen, please inform us so that we may update our records and keep track of (or help to track down) the unit.

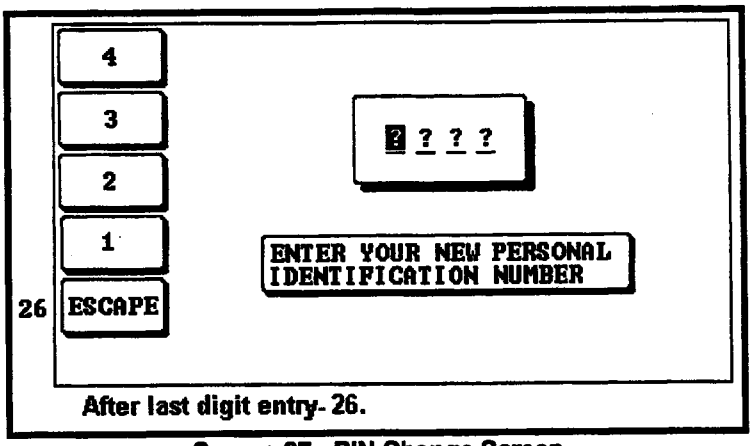
Your unit is warranted to be free from defects in materials or workmanship for a period of one year from date of purchase. Warranty will not cover failures due to abuse, misuse, accident or unauthorised alteration or repair. In the unlikely event of repairs being necessary, please return the complete unit, including antenna, in its carrying case, carriage paid to one of the addresses below.

Skyforce Avionics Ltd
5 The Old Granary
Boxgrove
Chichester
West Sussex
PO18 0ES
United Kingdom
Tel: +44 (0) 1243 783763
Fax +44 (0) 1243 783992

Skyforce Avionics NA
14100, Parke Long Court
Suite F
Chantilly
Virginia 20151
USA
Tel: + 1 703 502 7820
Fax: + 1 703 502 7802

This guarantee does not cover call out or on-site maintenance of the equipment.

If you require further help or advice on installing or operating your unit, please contact in the first instance the dealer from whom you purchased the equipment.



Screen 27: PIN Change Screen

When you access this Screen the cursor will be sitting over the first question mark. This represents the first digit of the PIN. Your new PIN can be entered from here by pressing Keys 2,3,4 or 5 (now labelled 1,2,3, and 4 in the illustration above). The numbers you enter will replace the question marks as they are entered and the cursor will step to the right.

When the fourth digit has been entered, the new PIN will automatically be transferred to the unit's Non Volatile Memory (NVM) and Screen 26 will be displayed, showing the newly-entered PIN. If you wish, you may press Key 1 at any time and this will take you straight to Screen 26 without making any change to the original PIN.

Auto Power-On Lock

Pressing Key 3, AUTO LOCK, on Screen 26, Pin Change & Power On Lock Enable Screen, allows you to switch the Auto Power-On Lock security feature ON or OFF. If you switch this Power-On Lock to ON, the unit will require your PIN to be entered every time you or anyone else switches it on. Although, as mentioned above, so long as the Power-On Lock has NOT been activated, you can key in as many PIN attempts as you wish, switching the Power-On Lock to ON changes this situation entirely.

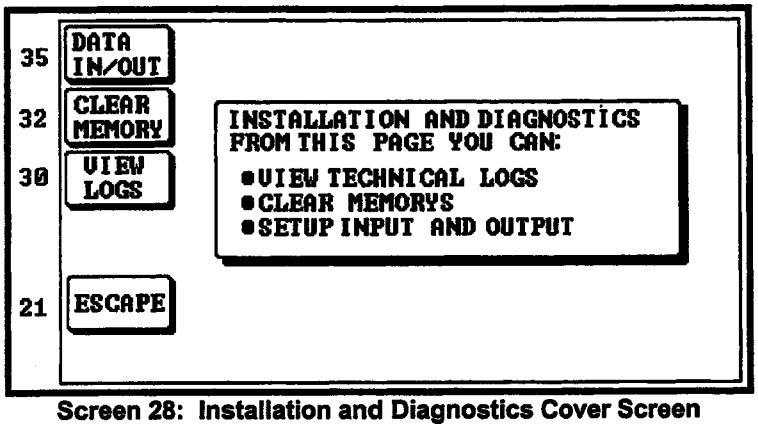
If an incorrect PIN is then entered three consecutive times at the switch-on stage, the unit will lock out and display Screen 55 (see Appendix 01). If this happens to you, in order to re-activate the unit, you will have to telephone Skyforce in the UK on +44 (0)1243 783763 or in the US on + 1 703 502 7820, tell them who you are and give them the Serial Number of your unit and the Lock-Out Number which you can read from the top of Screen 55. The operator at Skyforce will verify these details and check them against the Skyforce database and register of stolen units.

Once the operator at Skyforce is satisfied that the unit has not been stolen and that you are the officially recognised owner, you will be given an Unlock Code Number. This Unlock Number is a 10-digit number. In order to unlock your unit you must now enter this number correctly into your unit, still using Screen 55. The digits will replace the question marks as each one is keyed in. The Unlock Number is regarded by the unit as having been entered as soon as the last digit has been keyed in. Every time an incorrect Unlock Number is entered, the unit will generate a new LOCK OUT number. This makes it impossible for a would-be thief to stumble upon the Unlock Number by trial and error. The odds against a thief guessing the correct Unlock Code Number are 10 million to 1.

If you do ever get into a Lock-Out situation and then re-activate your unit with the Unlock Code Number received from Skyforce, remember that no matter what PIN you were using before, the PIN will now have been reset to the default digits of 1234.

Be very careful if you activate the Auto Power On Lock feature. Locking yourself out of the system can be very inconvenient.

Installation and Diagnostic Screens



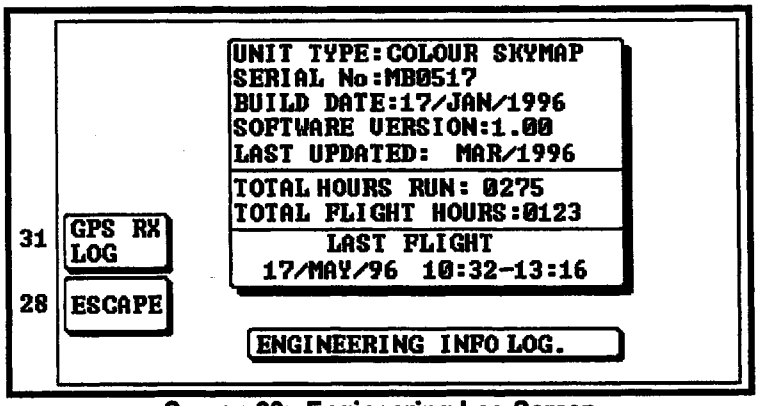
Screen 28: Installation and Diagnostics Cover Screen

This Screen is accessed by pressing Key 5, INST & DIAGS, in Screen 21, Setup Cover Screen, and gives you access to all installation and test-related Screens.

You can also use this Screen to gain full access to the "time in service" logs and "last flight" log. It is used, in addition, to enter four different "Memory Clear" routines, which are PIN-protected to prevent inadvertent damage to the unit's memory.

View Logs

Engineering Log



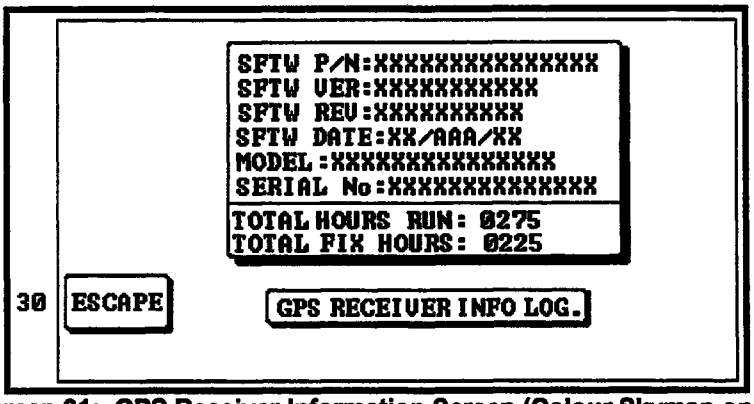
Screen 30: Engineering Log Screen

This Screen can be used to produce technical engineering information about the unit. Unit type, serial number and build date information were all stored within the Non Volatile Memory at the time your unit was initialised at the factory. The version of the software in use and the latest update information are stored on the data module.

The Total Hours Run value is updated every minute. This can give you an indication of the total time that the unit has been in operation. You can, however reset this figure, using Screen 33. (It is perhaps worth noting that a copy of the cumulative total of hours run remains recorded within the NVM, cannot be user-reset and can only be read by Skyforce technicians.) The Total Flight Hours is a value stored in exactly the same way as Total Hours Run, the difference between these two figures being due to the fact that Flight Hours are totalled only during periods when the Ground Speed is above 30 knots. Last Flight data is available only with the Colour Skymap. The Date and Start Time are logged as soon as the Ground Speed exceeds 30 knots and the Stop Time is logged whenever the Ground Speed drops back to less than 30 knots.

Key 2 is available only on Colour Skymap units and gives access to the GPS Receiver Engineering Log Screen 31.

GPS Receiver Information Log



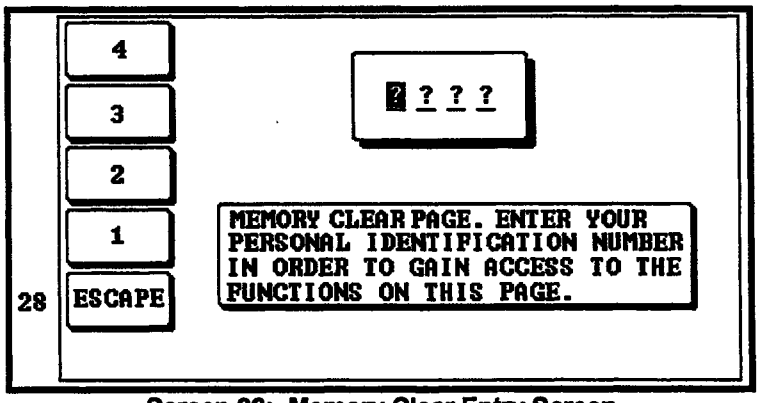
Screen 31: GPS Receiver Information Screen (Colour Skymap only)

Most of the information on this Screen is technical engineering information about the internal GPS receiver.

The Total Hours Run figure is increasing all the time there is power applied to the GPS receiver circuit. The Total Fix Hours figure increases only during the periods when the GPS receiver has a 2D or 3D fix.

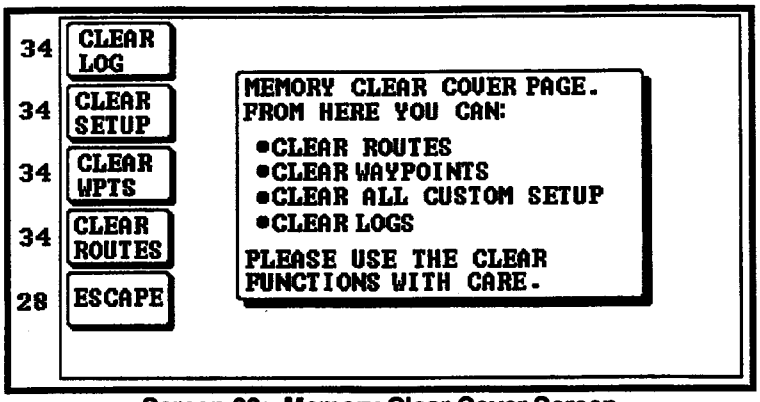
You can if you wish also reset these figures along with the Total Unit Hours Run value by using Screen 33.

Clear Memory



Screen 32: Memory Clear Entry Screen

All the routines which can clear the unit's memory are protected by your PIN specifically to prevent any unauthorised person wiping out the valuable data contained in memory. Therefore, when you enter this Screen the cursor will be positioned over the first of four question marks. You must enter your PIN at this stage before you can proceed to the memory clear functions on Screen 33. As soon as the fourth digit of a correct PIN is entered, the unit will call Screen 33. If the PIN entered is incorrect the display will switch immediately to Screen 25 (PIN INCORRECT) and then take you back to Screen 28, the Cover Screen for Installation and Diagnostics. If you do make a mistake, however, you are allowed to make as many attempts as you need to enter the correct PIN.



Screen 33: Memory Clear Cover Screen

Be careful to handle operations from this Screen correctly, otherwise you could lose valuable and important data from the memory of your unit.

If for instance you press Key 2, labelled "CLEAR ROUTES", you will go straight to a warning Screen that reads "Clear Memory. ARE YOU SURE?". If you then press Key 1 labelled "ESCAPE" it will take you back to Screen 33 again, without erasing any of the memory. If however you decide to go ahead and press Key 5 labelled "YES" then all the routes in memory will vanish from the unit's memory and you will not thereafter be able to recall this information.

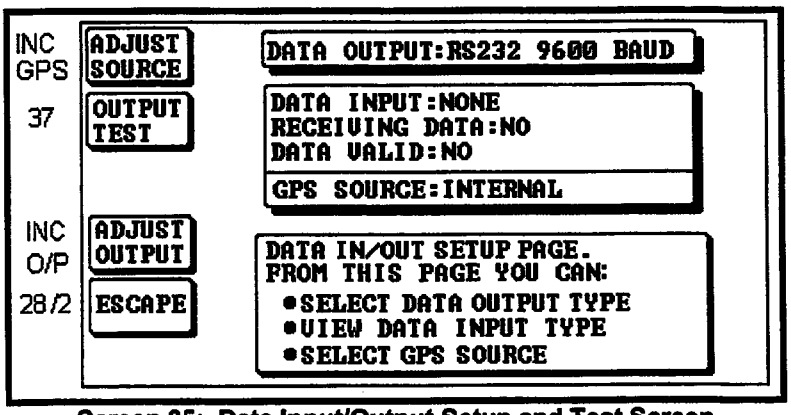
If you press Key 3, labelled "CLEAR WPTS", a similar procedure will be followed, and pressing "YES" will this time clear all Waypoints from memory including those being used in routes.

Use of Key 4, labelled "CLEAR SETUP", will reset all the User-Defined Options within the unit to their original default values.

Key 5, labelled "CLEAR LOG", resets the Total Time Run counters that appear on Screens 30 and 31, along with your logged flight data.

Key 1, labelled "ESCAPE", returns you to Screen 28 without altering or erasing anything in the unit's memory.

Data In/Out



Screen 35: Data Input/Output Setup and Test Screen

On entry to this Screen details of the current settings for data output are displayed in the top box. Settings can be toggled by pressing Key 2 and the options available are as follows. (The default settings are listed first.)

Colour Tracker: DATA OUTPUT: OFF / ECHO INPUT.

Colour Skymap: DATA OUTPUT: OFF / RS232 (AR NAV) 9600 BAUD / NMEA 0183 9600 BAUD.

Data output on Colour Tracker is limited to echoing the data input. This provides a useful buffer for connecting other listening devices to your GPS data output.

Colour Skymap can output standard aviation RS232 data at 9600 baud or NMEA 0183 format RMC, GGA and RMB sentences at 9600 baud.

The second box is for information only. The unit will automatically sense the type of incoming data. It first sets up the default data type (or last-used data type) and then if the incoming data is not recognised, it steps through the other data input options until it finds a format it recognises.

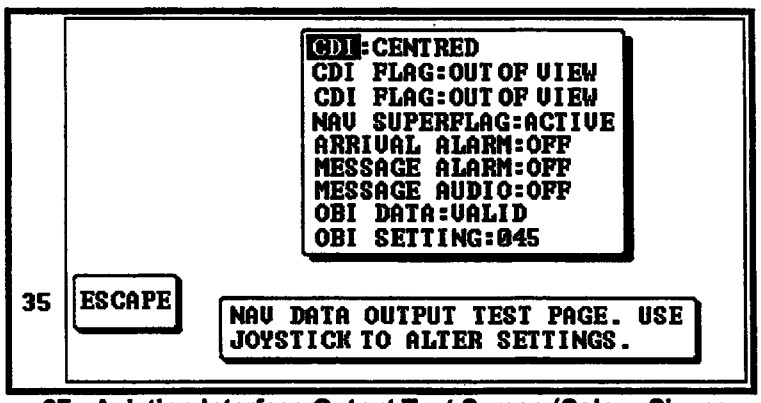
The data type the unit is looking for will be displayed next to the DATA INPUT heading. Once a valid format is found, searching will be disabled. For Colour Skymap, depending on software options, the data type that will be accepted are RTCM SVC-104 (which is differential GPS correction data at 9600 baud see Appendix 04 for further details), StormScope thunder storm location data or Shadin Airdata. Colour Tracker can accept NMEA or AR-NAV (RS 232) data both at either 4800 or 9600 baud.

Once a valid format is recognised and sentences are being decoded, the word YES will be displayed next to RECEIVING DATA. If the data is not recognised or is not present, the word NO will be displayed. If the data is valid and useable, the word YES will appear next to the words DATA VALID, if the data is not valid or useable then the word NO will be displayed.

The third box labelled GPS SOURCE allows you to use your Colour Skymap as a Colour Tracker. Pressing Key 5 will toggle the GPS SOURCE between INTERNAL and EXTERNAL. When set to INTERNAL, the internal GPS receiver will be used. When set to EXTERNAL, the Colour Skymap will use data generated by an external GPS receiver in the same way as a Colour Tracker does. If you have a Colour Tracker and select INTERNAL, an error message will be displayed after 5 seconds because an internal GPS receiver will not be found.

When Colour Skymap is used with an external GPS source, the data output will be limited to OFF and ECHO INPUT.

Output Test



Screen 37: Aviation Interface Output Test Screen (Colour Skymap only)

This Screen is designed to output test data to an auto pilot for use during installation and testing. It is not a Screen with which you as user of the Colour Skymap need greatly concern yourself. Should you inadvertently enter it (by pressing Key 4 on Screen 35) you can return to Screen 35 simply by pressing Key 2, labelled ESCAPE.